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A New Tool Grinding Machine.

We illustrate on this and the succeeding page an automatic tool grinder which has recently been perfected. The design is by Mr. F. W. Taylor, formerly Chief Engineer of the Midvale Steel Works, Nicetown, Philadelphia. A crude form of his machine has been in use at the above works for a number of years; the tool has now been developed and improved, and is one of the very few really automatic tool grinders. By reference to the prospective engraving on this page, and those made from drawings on page 2, its construction will readily be understood.

The operation of the machine is as follows:

The tool-holder is set upon an adjustable platen in front of the stone. By means of a cam and lever the stone is given motion back and forth in the line of its axis. This keeps its face square and true, and allows manipulation of the tool to better advantage. The tool-holder carries a sheet metal former corresponding to the form of the tool desired, this former resting against a hardened steel apron, which is attached to the hood of the stone, and made adjustable in and out by suitable mechanism, as shown. The former is set in the tool-holder directly over the tool, so that when it bears against the apron the tool comes in contact with the stone. The former in the tool-holder is held firmly against the adjustable apron by means of a light yoke and counterweight, this pressure serving to keep the tool in contact with the stone, when adjusted to its proper position. The platen on which the tool-holder rests can be adjusted to any desired angle, giving any amount of clearance to the tool.

An index plate is attached to the platen, by means of which the angle can be regulated. The platen is faced with hardened steel, having in it a series of parallel slots, and on the underside of the tool-holder is a small projection which, resting in any desired slot, acts as a center about which the holder and tool may swing. The pressure of the tool upon the stone being controlled by an adjustable counterweight, the operator has simply to swing the holder from side to side, or move it back and forth, and the shape of the former is of necessity reproduced in the tool.

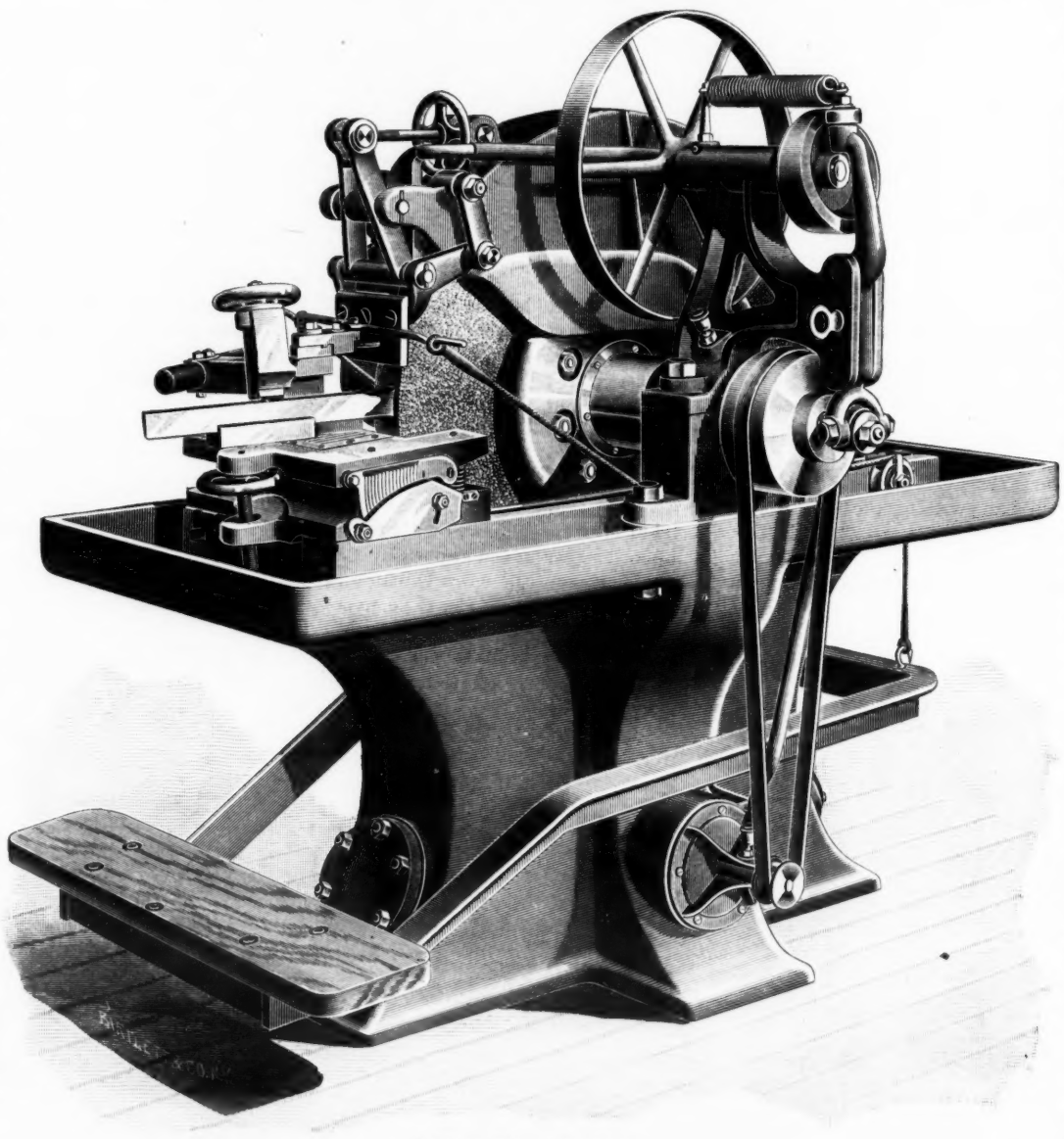
When the operator desires for any reason to remove the tool or draw it back, his foot placed on the treadle releases the pressure, and the holder is instantly free. Water is fed to the stone in the ordinary way by a rotary pump; the base of the machine acts as a receptacle for the water, which can be drawn off by means of a cock, and the tank cleaned through handholes front and back as shown. The driving pulley is on the left-hand side of the machine.

All the mechanism for manipulating the tool is arranged so that it will readily move up to the stone as wear takes place. The best and most suitable materials are used in each part.

Every provision is made to protect the bearings from grit, and the holder is fitted in a substantial and workmanlike manner.

The stone ordinarily used and recommended by the makers is a natural product imported from England, known as "Free Grit." This stone recommends itself for its rapid cutting and low cost; although it wears more rapidly than emery, it gives more service per unit of cost. It also has less tendency to heat and burn the tool.

This grinder is of simple construction, and will form automatically any tool known to machine shop practice. It is being put on the market by the Niles Tool Works, of Hamilton, Ohio.



A NEW TOOL GRINDER.

News comes from New Haven of a waiter who contracted with the keeper of a popular restaurant to work for him a certain length of time, receiving as pay one cent a day, doubling each day the amount of the preceding day's wages. Now the waiter is suing the proprietor for some millions of dollars. It would appear that the waiter remembered his arithmetic better than the proprietor did his.

Light Weight Boilers and Engines for Mountain Transportation.

BY OBSERVER.

As an engine builder I was called on some years ago to design and construct a boiler and engine of 85 horse-power, and no piece of either (as per terms of specifications) was to weigh over 280 pounds. Since that time I have known of many similar specifications for steam machinery, but we have yet to know of an instance where this class of machinery, when erected and subjected to service, has really been satisfactory to the designer, builder or purchaser.

In my own case, the boiler was the item that did not suit me, owing to its construction cost, which amounted to twenty-five dollars per horse-power. It was water and fire tube combined. It is not difficult work to design a sectional engine of the slide or piston valve types that will show a moderate rate of construction cost, but if the Corliss plan is called for the cost will be somewhat extravagant, as the speed cannot be more than 110 revolutions per minute, if the action and life of the valve gear is to be considered.

My engine for 85 horse-power had two 8"x10" cylinders, cranks set at 90°, piston valves, Pickering governors, engines running at 300 revolutions at speed, cut-off fixed at three-quarters of the stroke, boiler pressure 125 pounds per square inch. The bed-pieces were yellow pine, and the cylinders and main pillow blocks were attached to each other by steel rods which acted as guide bars.

These engines cost less than six dollars per horse-power, including erection, but of course not including transportation.

We now have in the market an enormous variety of high-speed automatic steam engines, but few, if any, are so designed as to comply with the requirements of what is known as man and mule transportation.

Many of the modern gold and silver plants have their engine power divided into two, and even three sets of engines, as with this system each department can be run separately. The power generally needed varies from 80 to 250 horse-power, although some mills require 400 horse-power.

We think the builders of the high-speed automatic engines should make an engine (say 10" x10") for such service, to be used singly or double as the case may require, no piece weighing over 275 pounds.

As to the boilers for this kind of work, it does seem as though all of the sectional boiler builders could at this date fill the bill at a fair cost, say sixteen to twenty dollars per horse-power f. o. b. shops, calculated at 30 pounds of water per hour.

A fire tube boiler can be made for this business that can be relied upon as safe and durable, at a price f. o. b. shops at about eighteen dollars per horse-power.

These boilers, water or fire tube, should have tubes at least 2½" in diameter. The design for the settings should be simple, and contain as few fire-brick as proper efficiency will allow, as fire-brick are very expensive in most of the mountain mine countries.

The fire bars should be in two lengths, with a center bearer, and the whole length of the furnace should not be less than 58" to receive wood cut in lengths of four feet.

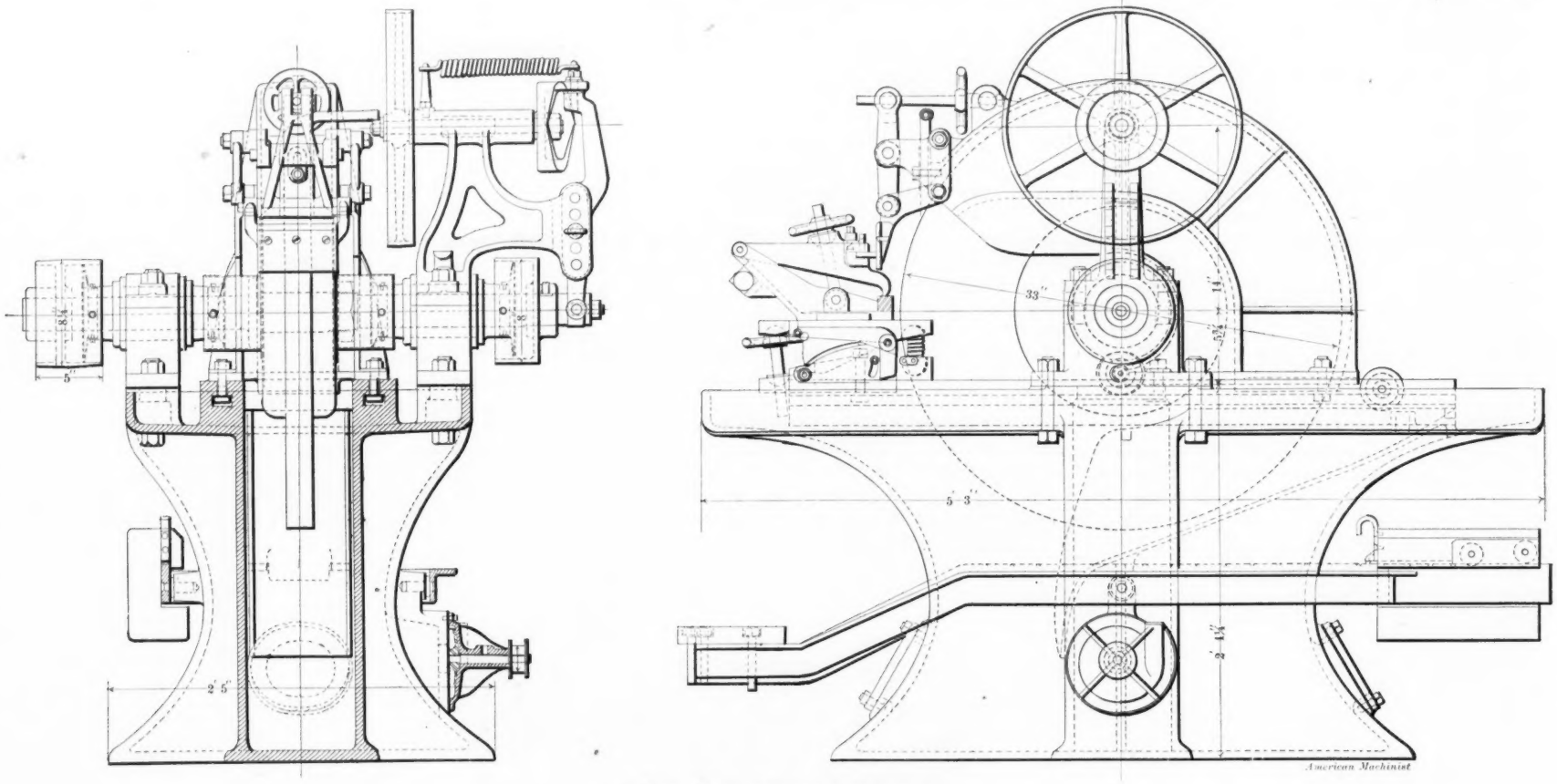
For my 85 horse-power engine, I allowed 1,300 feet of heating surface, and 36 square feet of grate surface, but of course the automatic high-speed engines of to-day would reduce these figures materially. One of the chief requisites for this service is a practical and economical filter-heater, for on this apparatus we must depend for the life of the boilers. The heater should have enough tube surface to keep the temperature of the feed water to 200°.

All manhole and handhole plates and seats should be faced, as this class of machinery must be of necessity placed in hands of men of limited experience.

Nests of 2" coils, each coil weighing about 280 pounds, and connected to a sectional steam chamber have been used for this pur-

pose with considerable success, as with ordinary firing and fair water these coils will last four or five years, but with bad water six months will generally finish them.

In about one-half of the instances where specifications called for this class of work, iron smoke-stacks are specified; these can be made of light material and lined with clay.



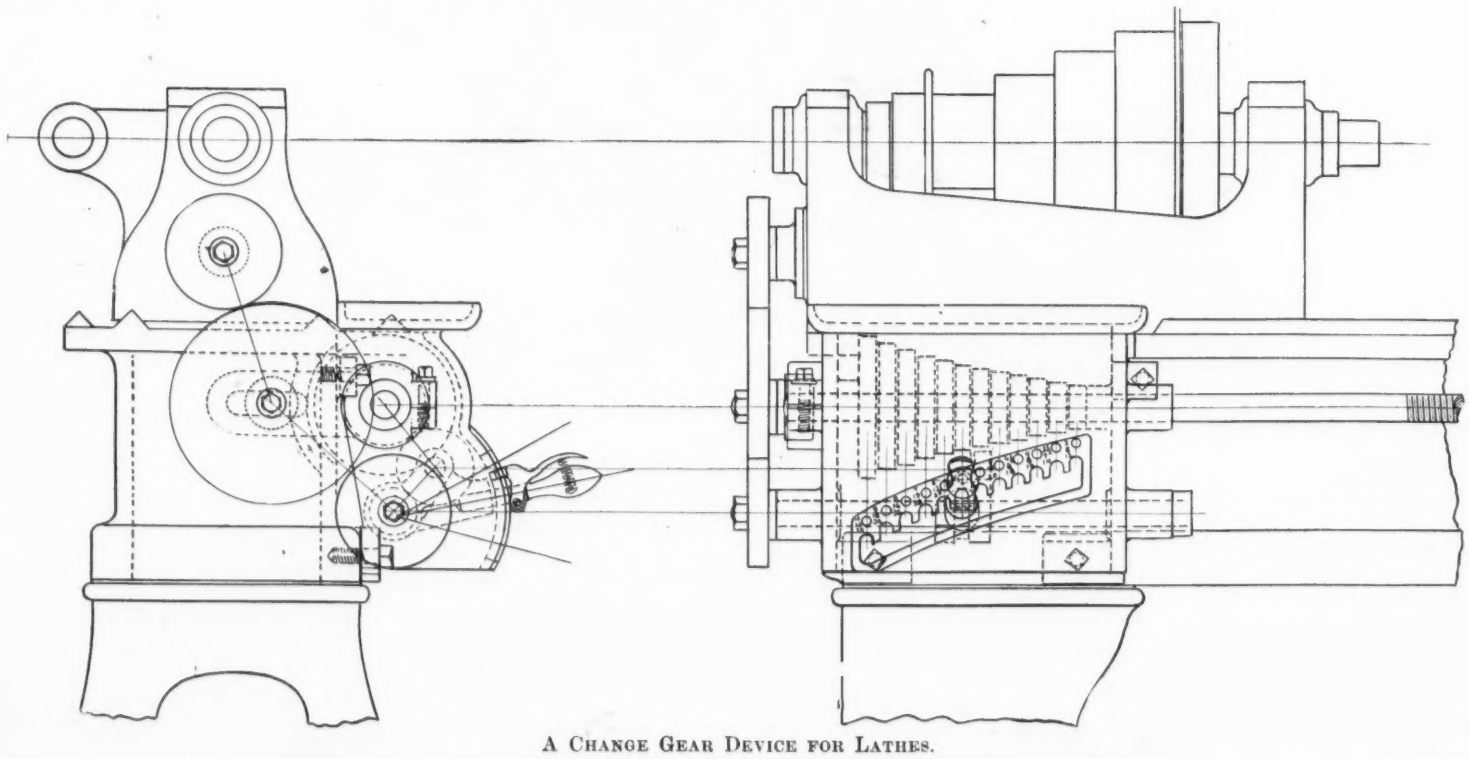
A NEW TOOL GRINDING MACHINE.

I think the subject of this paper is worth the consideration of the high-speed engine builders, as I know of no real special steam machinery suited to this class of power.

The makers of crushing and granulating machinery have reduced their details to the required weight, by making the structures sectional, and by using forged steel in construction.

A Change Gear Device for Lathes.

The accompanying illustration was made from the drawings of the inventor of the device, the object of which is to so arrange the change wheels of a lathe that any one of them shall be instantly available for use in cutting screws or feeding by the simple movement of a lever. Of course, the device may be applied to a lathe in various ways, our engraving showing it as adapted to be put onto a lathe already built, in which form it appears as an attachment that is bolted to the side of the bed under the head-stock, in which position it projects from the bed scarcely more than the carriage hand-wheel, and the top of the case forms a convenient shelf for the reception of tools.



A CHANGE GEAR DEVICE FOR LATHES.

It will be noticed that the arrangement of the change gears at the end of the lathe is the same as usual, the gear on the stud driving an intermediate, which, in turn, drives a gear which is on the end of a short shaft under the lead-screw. On this shaft there is a sleeve which is driven by a spline, so that it is free to move endwise on the shaft, to the sleeve being attached a gear wheel, which, by means of an intermediate, can be made to drive any one of the change gears which are permanently keyed to the lead-screw above. This intermediate spoken of is supported by an upward extension of the lever seen projecting from the front of the case, this lever taking hold of the sleeve by a fork, and enabling it to be moved endwise on the shaft to engage with any gear on the screw. It is thus seen that the screw is driven at a rate depending upon the gear which is engaged, and it is easy to arrange these gears in such a way that all the ordinary threads, say from 6 to 20 to the inch, can be cut simply by moving the lever from one position to another, while for extra threads provision can be made the same as with the ordinary lathe, *i. e.*, by changing the gears at the end of the lathe. As shown, the screw has upon it 12 gears, which means that 12 different threads can be cut, or 12 different rates of feed obtained by moving the lever, while by making a change of gears at the end of the lathe 12 more threads or rates of feed are obtained.

Where a feed rod is used, it can be driven by a clutch gear from the screw or from a sleeve placed upon the screw if desired, so that the screw need not revolve except when being used.

By placing the lever in any notch shown in the plate through which it passes, the corresponding thread is at once obtained, the latch locking it in position, and also locking it out when the lever is depressed and the latch released, thus disconnecting the screw. Figures stamped at each notch indicate the thread cut. Where a lathe is to be built for this device, the gears can as well be placed within the bed and the handle can then project through the side, and it can also easily be applied to cases where the screw is within the bed.

Besides the convenience of this device, it prevents the gears being lost or mislaid, keeps them clean without the necessity for providing cupboards or other receptacles for them. Its advantages where no feed rod is used, and the feeding is done from the screw, are apparent, since it gives a wide range of feeds without the necessity for changing gears. It is the invention of a well-known engineer and designer of tools, Mr. W. P. Norton, 156 S. Fulton Ave., Mt. Vernon, N. Y.

Improved Rapid-feed Flooring Machine.

We present on page 3 an illustration of a flooring machine, which is arranged to plane all four sides simultaneously, forming the tongue and groove at the same time. The cutters are arranged to operate as close together as possible, with the object of bringing them all into the best possible relation to the feed and pressure rolls, and to each other. Improved devices are used for weighting the feed and pressure rolls, and there are improved chip breakers.

The spindles are all of tool steel and the heads forged steel, supported in boxes which are joined together in such a way that it is impossible for them to get out of alignment.

The box caps are let together by a planed tongue and groove, and cannot twist or get out of line. The pressure bars are arranged to raise and fall with the cylinder, and can be set to and from the cutters for ordinary surfacing or deep cutting, moldings, novelty siding, etc. The pressure bar on the rough lumber is arranged to yield any distance by raising and swinging on the same center as the cutter head, allowing a closer adjustment. The pressure bar on the finished lumber is made to yield a limited amount for wet or resinous lumber, etc.

The under cutter is located next to the matcher heads, and admits of all stock being fed through regardless of wedge or taper ends, etc. Special pains have been taken to so arrange this under cutter that it will be as close as possible to the matcher cutters, the object being to do all the cutting on four sides within as short a space as possible, and with the aid of special and heavy

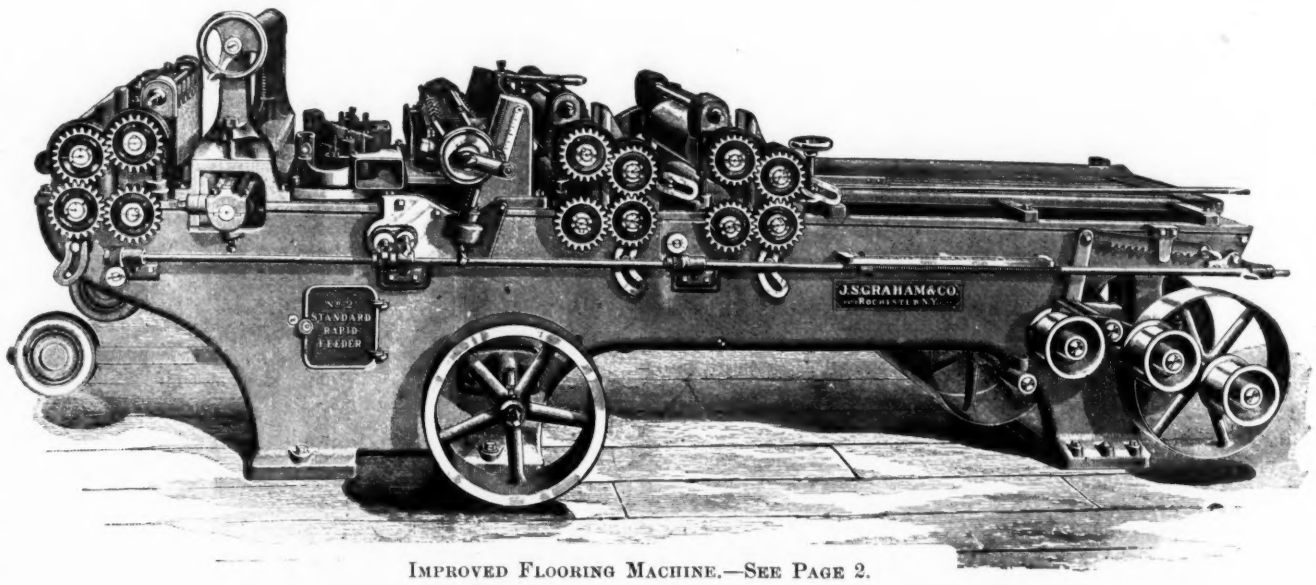
pressure bars insure perfect work on hard wood. It is very convenient and accessible to operate and adjust, and is very solid and heavy in all its parts. The under cutter head is from solid forged steel, slotted on four sides, and fitted in bearings 11 inches long, 2 inches diameter. It is arranged to raise and lower for surfacing, beading, rabbeting, etc., and has all conveniences for manipulation.

The side cutters are of late design, and will be found to meet all requirements. The spindles are of tool steel, 1¾ inches diameter, fitted in long bearings, and run on patent self-oiling and self-adjusting step.

The left-hand head travels across the machine by turning a crank either at the side or end of machine. The right-hand head and guides are also moved across the width of machine by turning one crank. By this improvement lumber of any width is beaded with the tongue to the guide, and equal wear obtained for the bed, pressure bar and knives. Both heads are fitted with a patent shavings hood, and the left-hand head has a patent chip breaker, which swings or gives any reasonable distance backwards.

There are six feed rolls driven by a heavy train of powerful gearing. They are also fitted with an improved balanced expansion gearing and parallel movement, avoiding the possibility of tipping the rolls endways, and straining and breaking the gearing. This improvement allows the rolls to yield or jump at least two inches, and easily pass over stub shots, etc., as well as to give equal pressure on both edges of the board, and cause it to always hug the guide and feed it through straight. The method of raising and weighting the feed rolls is new, and free from the usual top rigging and obstructions. The feed works are arranged to feed from 30 to 120 feet per minute.

The machine works 14 inches wide, 6 inches thick, 14 feet long, and weighs 8,500 pounds. It is built by J. S. Graham & Co., Rochester, N. Y.



IMPROVED FLOORING MACHINE.—SEE PAGE 2.

The Bethlehem Iron Company, of South Bethlehem, Pa., will make an extensive exhibit at Chicago, including steel rails, a battleship shafting 125 feet in length, guns, projectiles, an armor-plate ingot weighing 100 tons, and various naval appliances. The company will also erect a full size model of its famous 125-ton steam hammer, said to be the largest in the world. It will be to all appearances a perfect duplicate in every respect. It will span the main avenue of Machinery Hall, and will rise to a height of ninety feet. At the last Paris exhibition great attention was attracted by a similar model shown by the Creusot Works, but representing only a 100 ton hammer.

The Burnham Steam Pump.

The accompanying illustrations represent a new steam pump recently designed by F. A. Burnham, M. E., and manufactured by the Union Manufacturing Company, Battle Creek, Mich.

Fig. 1 is a plan of the main cylinder face, having the same arrangements of ports as the chest cylinder shown in Fig. 2. A longitudinal section of the pump is shown in Fig. 3. Motion is imparted to the slotted arm and segment gear *A* (Fig. 3) by means of a crosshead and roller on the piston-rod. This gear meshes into a rack sliding in a guide, and moving freely on the auxiliary valve stem *a*, on which tappets are fastened to engage with the rack when near the completion of its stroke, and as the piston continues to move towards the end of the stroke, the auxiliary valve *H* in Fig. 2 moves in a direction opposite to that of the piston. The alternate action of this admits steam automatically through the double ports *b*, *b'* and *e*, *e'* (Fig. 2) to each end of the chest cylinder, causing the chest piston *I* to move the main slide valve *D* in Fig. 3, which in its turn admits steam to the main cylinder through the double ports *E*, *E'*, and *e*, *e'*. As the travel of the rack is only one-fifth of the piston travel, it will be seen that the valve moves slowly and without jar or noise, due to a long travel and rapid motion.

The operation is as follows: Steam is admitted to the steam chest at *B* (Fig. 3) into the space *F*, between the chest piston heads and into the auxiliary valve chest *G*, shown in Fig. 2. When the auxiliary valve *H* is in the position as shown, steam passes into both the ports *b'* and *e'*, but as the port *b'* is closed by the chest piston *I*, no steam can enter the chest cylinder through it, but the other port *e'* extends to the extreme end of the chest cylinder, and being never covered by the piston is open, and admits steam into the space *J*; as the port is drilled small, the space is filled slowly, and the piston moves gradually until it uncovers the large port *b'*, when the full volume of steam is admitted, moving the piston over to the opposite end of the chest cylinder. During this movement of the piston, the large port *b* is open to the exhaust *E X* until it is covered by the chest piston, and then the small port *c* is covered by the lap of the valve (see *e'*, Fig. 1) and has no connection with the exhaust, and consequently, there being no outlet for the exhaust vapor, it is compressed, and forms a cushion for the chest piston *I*.

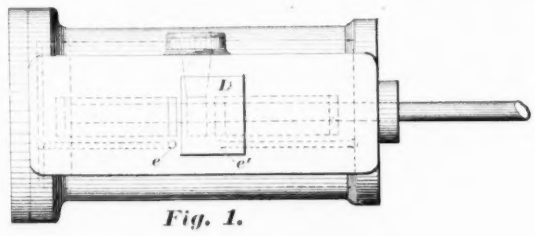


Fig. 1.

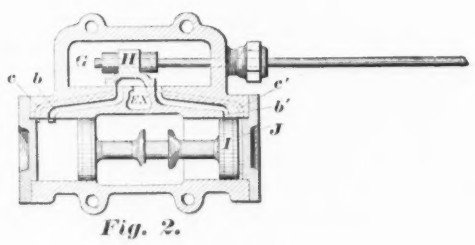


Fig. 2.

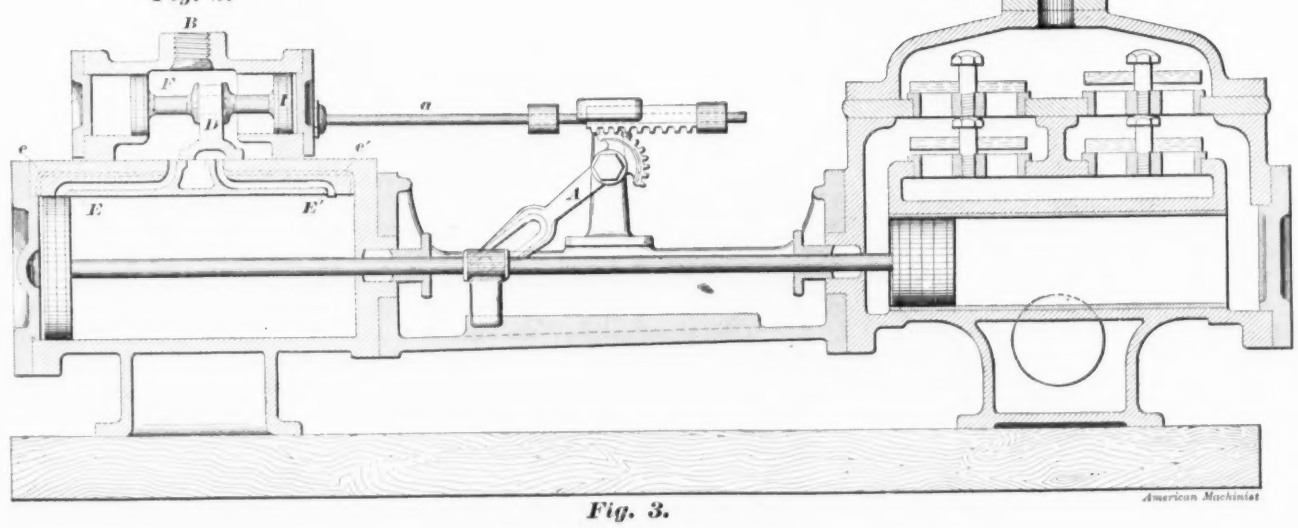


Fig. 3.

THE BURNHAM STEAM PUMP.

The chest piston in its movement carries with it the main valve *D* (Fig. 3) admitting steam to the main steam cylinder through the double ports *E*, *E'* and *e*, *e'*, which are arranged the same as in the chest cylinder, and the same cushioning and slow starting of the piston occurs in the main, as in the chest cylinder.

The advantages of this arrangement are a perfect cushion insuring a uniform travel of piston under varying conditions of load. A momentary pause of the piston at each end of the stroke causing the water valves to seat quietly without shock or jar, and a slow, initiatory movement of piston, whereby the water columns are started gradually, relieving the pump and piping of undue strains.

This arrangement also admits of combinations of steam and water cylinders for different duties. They are made single, or coupled in pairs on one baseplate. The advantage of this is that, while in fact duplex or double, they are not dependent one upon the other, and should anything occur to one side, the other may be speeded up and the same duty performed until repairs can be made.

These pumps are made in sizes for feeding boilers from 10 to 1,600 horse-power, and for various tank and other duties required of steam pumps. The cylinders are made interchangeable, and should an accident or breakage occur in either steam or water end or center, the broken part may be replaced without its being necessary to replace the whole pump.

Wanted to See the Boilers Shake.

Conrad Studel is a German, 20 years old, living at 13 Crosby street. For a week he has been working for James Rice, who runs the boilers in the five-story building at 152, 154 and 156 Grand street. He made the fires and wheeled out the ashes.

Yesterday morning Engineer Rice went out to get breakfast, leaving Studel in charge of the boilers. Studel opened the draughts and heaped on the coal. He fastened the safety valves so they would not work. Then he sat down and waited. The steam indicator rose, but Studel sat still. The boilers began to tremble, but he did not move.

Inspector of Boilers Lilly happened to pass the building and heard the rumbling of the imprisoned steam. He hurried to the basement, drew the fires, and let off the steam. Studel was arrested and taken before Justice McMahon at the Tombs.

He said he didn't intend to blow the building up, but only wanted to see the boilers shake.

He was held in $500 bail for Special Sessions.—*The Sun.*

A Disastrous Boiler Explosion.

On Monday morning, Feb. 29, 1892, about 5.50 o'clock, the two boilers which furnished steam for the stationary engine used to drive the machinery in the machine and car shops of the S. F. & W. R. R., at Savannah, Ga., exploded with terrible force, instantly killing the engineer, Jno. C. Murphy, and a colored engine wiper named Hopkins, also destroying several thousand dollars' worth of property, such as a two-story brick building, about 50 feet by 65 feet, machinery of various descriptions, and the entire stock of patterns, which was large and valuable.

We have obtained the following particulars in regard to this explosion, and photographs of the wreck, from which the engravings on this and the succeeding page were made.

There were two steel boilers 14 feet long, 54″ diameter, with 34 4″ tubes in each—shell, $\frac{11}{32}$″ thick; tube sheets, $\frac{9}{16}$″ thick; stays, 1″ diameter; longitudinal seams, double-riveted; cross-seams, single-riveted; mud leg near rear head, 14″x20″, with blow-off connections; steam drum, 10 feet by 24″, connected to boilers with about 2 feet of 3½″ pipe, and a Chapman gate valve. The steam gauge and a 4″ Crosby pop valve were connected to drum. The furnaces, steam and water connections were so arranged that either boiler could be used independent of the other, should circumstances ever require it, in case of repairs, etc. The boilers were blown out Saturday night and washed out as usual on Sunday by the engineer and his regular fireman. About three o'clock A. M. Monday, the hostler, named Lloyd, started the fires, as was his usual custom; had three full gauges of water; he filled the furnaces with wood, and went to the roundhouse to look after some locomotives that were to go out on early trains; he returned in about a half hour and refilled the furnaces, and left the colored wiper Hopkins to look after things while he went to the depot to meet an incoming train. When he returned, he saw Hopkins sitting on a block of wood in front of the boilers, and the engineer in the engine-room oiling his engine, which was directly in the rear of the boilers, say 8 or 10 feet distant; he asked the engineer if everything was all right; he responded that it was, and that he (Lloyd) might go home; he looked at the gauge and it showed 60 pounds of steam. Lloyd went directly to the roundhouse, which was about 300 feet distant, and after about five minutes the explosion occurred. The boilers stood nearly north and south, fronting the latter point. The force of the explosion seems to have been nearly southeast, although the building above referred to was blown to the four points of the compass and within a circle of 500 feet radius; as a policeman who was near by expressed it, "a rat could have hardly escaped with his life." The white spots shown upon the roof of one of the buildings in the engraving indicate plainly how thickly the brick dropped about that vicinity; this roof was about 200 feet from the boilers.

The engine was in the brick building, as were also the offices of the master mechanic and foremen of the various departments. The upper floor was used as a pattern loft, and contained many valuable patterns. The boilers were alongside this brick structure in a small wood frame building covered with corrugated iron. The initial point of rupture was undoubtedly at the manholes, which were located in the rear sheets, which appear to have opened longitudinally through the manholes, and did not move very far from their original position. Directly opposite the manholes were the mud legs above referred to. These sheets are plainly shown in Figs. 9 and 10, taken after they had been removed with the other debris. The sheet shown in Fig. 1 was blown in a southeasterly direction, and landed about 300 feet from its starting point on the railroad track, severing a solid 60-pound steel rail, which naturally stopped its flight. The form of this sheet was entirely changed, as will be seen by the stays or braces that were attached to the front head. The drum shown in Fig. 8 followed the same course as the above-mentioned sheet, and landed about thirty feet nearer its starting point beside the track, uninjured except slight depression on one side. The valve forming part of the connection between drum and boiler is plainly shown in the cut intact, except rim of the hand wheel; this valve was closed when first discovered after the explosion occurred. The valve in the connection between the other boiler and drum was found with the piece of pipe above referred to still attached to it, about 500 feet east of starting point, half buried in the soil; this was also closed when exhumed. The piece of pipe shown with the tube sheet in Fig. 2 was blown about one-third of a mile in a southwesterly direction, and landed on the roof of a two-story dwelling, cutting its way through to the floor. It is hardly necessary to remark that the occupants were not a little surprised by this unceremonious early morning visitor. We are informed that these boilers were made by the Kensington Engine Works about six years ago, and that they were two boilers of which the designer and makers may justly feel proud. An examination of the wrecked boilers showed no particularly weak points by this unusual test to which they were subjected, indicating that the designer had carefully calculated the strains, and that the workmen had put the material together in a proper manner; it was a general giving away of the entire structure under a terrible force which it is impossible for the uninitiated to comprehend. Single and double-riveted seams gave away alike, and parallel to them, 8″ or 10″ distant, the solid steel sheet was torn like so much wrapping paper. In some places the one-inch stays were broken off; in others, the rivets by which they were fastened to the shell were cut off; in others, the angle irons on the tube sheets by which they were fastened were torn out; in others, the ¾″ pins that went through the angle irons and ends of stays were

Fig. 1.

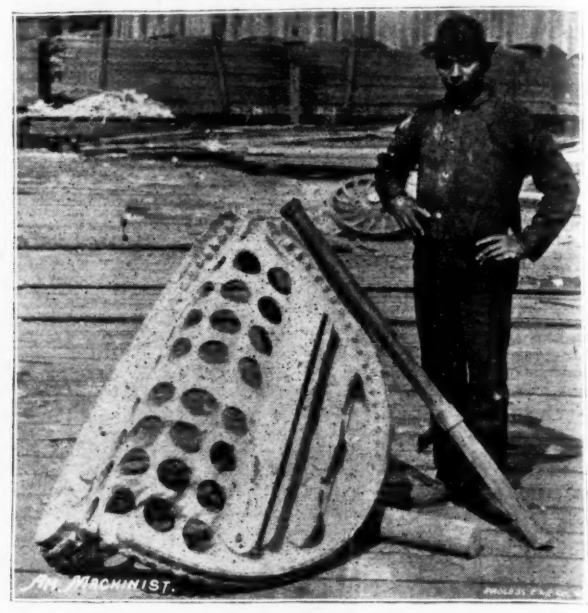


Fig. 2.

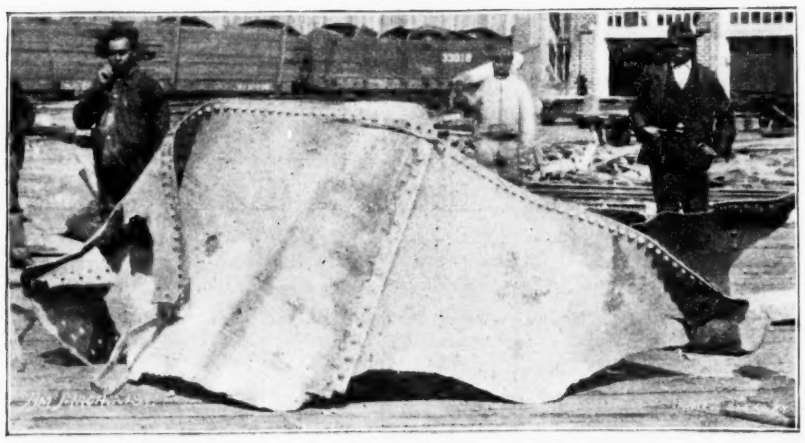


Fig. 3.

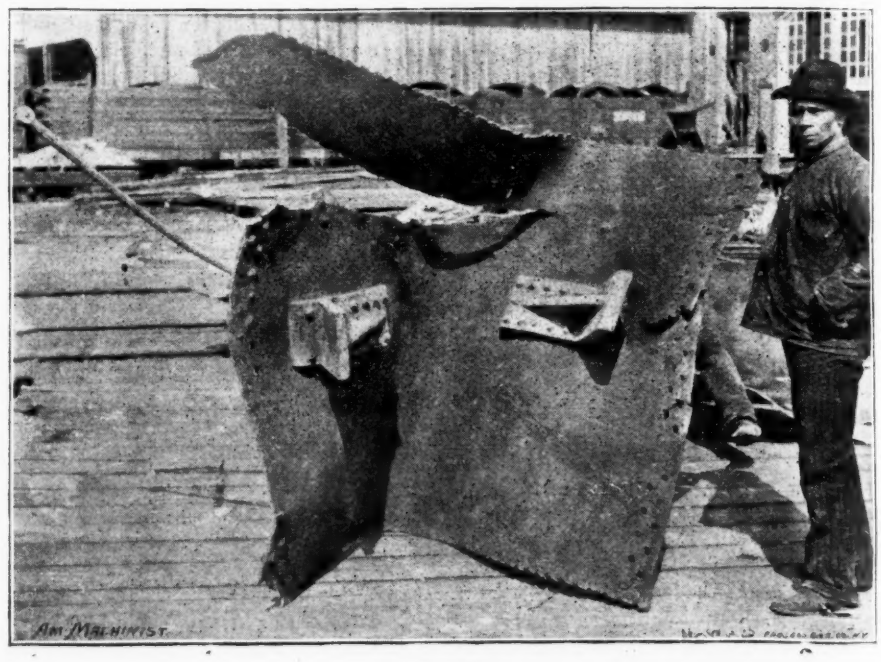


Fig. 4.

Fig. 5.

sheared off just the size of the end of stay (see Fig. 4). Lloyd says he saw the steam-gauge showed 60 pounds of steam when he left, which was no doubt a fact, as the gate valves were seldom used, and leaked sufficiently to fill the drum, and show 60 pounds on the gauge. Now the only mystery about this explosion is, who, when, and for what purpose were those two valves closed? and this will probably never be solved.

Fireflies from Cuba.

Secretary Langley, of the Smithsonian Institution, has been experimenting for some time past with fireflies from Cuba. He says that the light they give is the "cheapest" in the world produced, that is to say, with the least heat and the smallest expenditure of energy; and he believes that a successful imitation of it would prove a most profitable substitute for gas and electricity. The insects are beetles two inches long and belong to the family of "snapping bugs," so called because when one of them is laid on its back it snaps itself into the air with a clicking sound.

The secret of the light this firefly gives is as yet undiscovered. Apparently it is connected in some way with the mysterious phenomena of life, and chemists and physicists have sought in vain to explain its origin. On each side of the animal's thorax is a luminous membranous spot, and these flash at intervals, so that the Cubans put a dozen of the insects in a cage together, and so obtain a continuous illumination bright enough to read by. This light is accompanied by no perceptible heat, and is seemingly produced with almost no expenditure of energy.

How great an improvement it represents upon all known artificial light can be imagined when it is stated that in candlelight, lamplight or gaslight the waste is more than 99 per cent. In other words, if they could be so obtained as not to throw anything away, they would give nearly 100 times the illumination which they do afford. Even the electric light is mostly waste.—*Washington Star.*

Items for Pattern-Makers.

BY P S. DINGEY.

I.

It is surprising the amount of time and money which may be saved in the machine shop and foundry when attention is given in the pattern shop to what is sometimes termed the smaller matters of the business. Usually the more important details do not wear us half as much as the ever-recurring little set-backs. For instance, how often it happens that the machinist has to chip away a cylinder head at *A*, like shown in Fig. 4, page 6, to prevent it from choking the port of the cylinder, when the pattern-maker might just as well have cut the clearance on the head back far enough to clear the port $\frac{1}{8}$", and thus save the machinist's time. I do not think any M. E. would be fine-haired enough to object to the small amount of extra clearance space that this would give.

Again, what unnecessary trouble might be saved sometimes in chucking a casting in the lathe, if some lugs or other projections, that could easily be broken off the casting, had been put on the pattern to facilitate the holding of it. I have often seen a machinist with a casting on the planer or lathe puzzled how to hold the "blamed thing," as he would name it, from jumping out of the machine, when perhaps a little foresight in the pattern shop would have made matters easy. A good pattern-maker will consider these things and look ahead, following his job in imagination through the foundry and into the machine shop.

Another thing along the line of items, and which is generally overlooked: when a cylinder casting has to be lagged with black walnut, the pattern-maker should make provision on the backs of the flanges for supporting the lagging, similar to that shown in Fig. 2. This is a much better method than blocking the lagging off from the body of cylinder with blocks fastened on back of lagging.

The edges of the flanges at *x*, Fig. 3, should not be rounded off, as is often done. When flanges are extra wide, they might be cored out by setting a ring core on the backs of flanges, similar to that shown in Fig. 3.

By providing for the cylinder lagging this way, a better and cheaper job can be done than otherwise, when no provision is made.

Stamping or marking with black varnish the diameter and length of all core prints on every pattern is very simple, and apparently unimportant, and yet if this practice were general, I fancy the molders would pronounce an everlasting benediction on the pattern-makers, especially the molders who never have any calipers or rule—in fact, it would be an all-round convenience and a preventive of mistakes.

Many circular pieces of work in the foundry are covered with slab cores to save ramming up a cope, and a core-box for these slabs is usually a very simple piece of work, and yet nine times out of ten the cores when made and located do not fit on the ends, but will remain open, either on the inside or outside in the manner shown in Fig. 1. If the molder should butt the ends closely together, the cores would not cover the mold, but would run off somewhere on the outside or inside, as the case may be. Now, I do not mean to say a pattern-maker cannot make a core-box of this kind, and not make the ends radial, so that the cores shall fit closely together when laid down, but there is a very simple way by which the ends of these slab cores can be made to fit without any trouble to the molder, and that is, by making one end round and the other hollow, as shown by dotted lines in Fig. 1. By this method the ends can be kept close together, and the cores located in their proper place when covering the molds.

The amount of stock that should be allowed on a pattern for finishing in the machine shop is a source of trouble to some pattern-makers. Among the first questions that many will ask their foreman when given a new job, are, How much stock shall I allow for boring? How much for planing? and so on. It is almost impossible to establish any rule that shall be uniform as to the amount of extra stock that should be allowed—for while $\frac{1}{8}$" is not enough for some jobs, for others it may be too much. Circumstances and a workman's good judgment can alone determine the proper quantity to allow.

A dry sand casting will not shrink or strain as much as a green sand one, and in large work the shrinkage is uncertain, so that before a pattern-maker can intelligently allow the desired amount for finishing, he should know the conditions under which the casting is to be made, and it will help him in his conclusions to get acquainted with the style or manner in which the molders are accustomed to turn out work, for in some foundries the molders will put on all the stock necessary for finish, and a great deal more, without the pattern-maker allowing any.

It makes all the difference in the cost of a piece of large machine work, which has to be turned or planed to correct measurement, whether the machinist has to take three or four roughing cuts or just one; whether he has to take off an inch and a half, where a quarter of an inch would have answered. Then, again, the pattern-maker must not be too "skinny" about allowing stock, or he will give the machinist more trouble than by allowing too much—of the two evils, too much to take off a casting is rather to be desired than not enough. Insufficient stock on a complicated casting will make a machinist bless the pattern-maker in a manner not too complimentary.

One-quarter of an inch ($\frac{1}{4}$-inch in the diameter) ought to be enough for boring out say a 20"x48" cylinder, but if the same amount only was allowed on a 40"x72" cylinder, the bore in all probability would not clean out to proper size; $\frac{3}{8}$" or $\frac{1}{2}$" would not be too much on such a large cylinder.

Fig. 6.

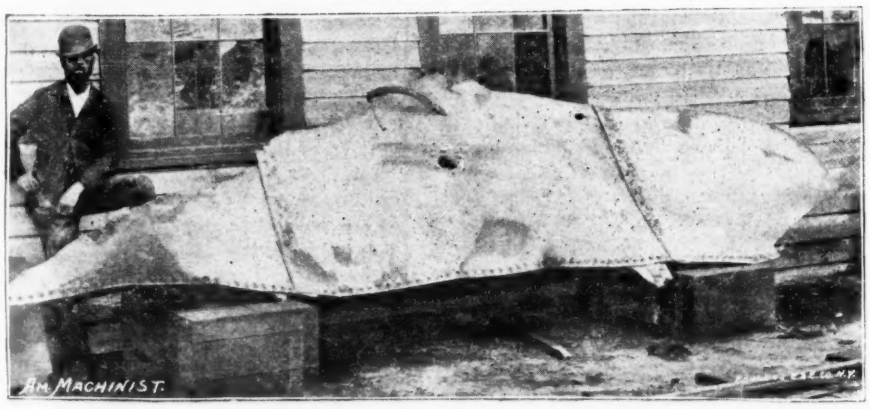


Fig. 7.

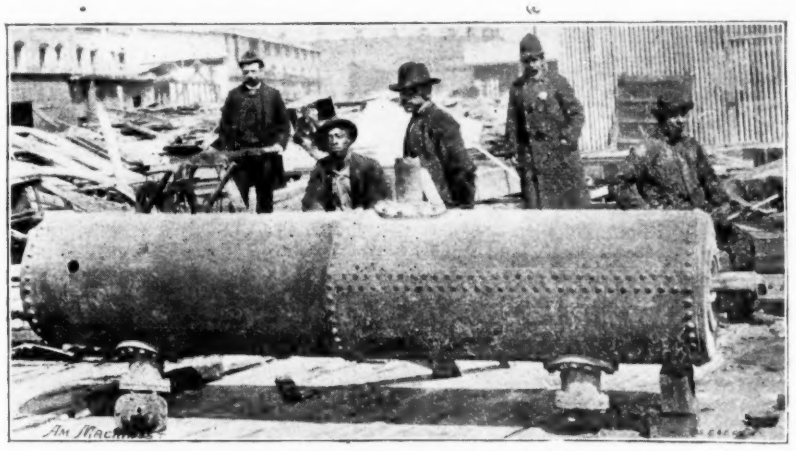


Fig. 8.

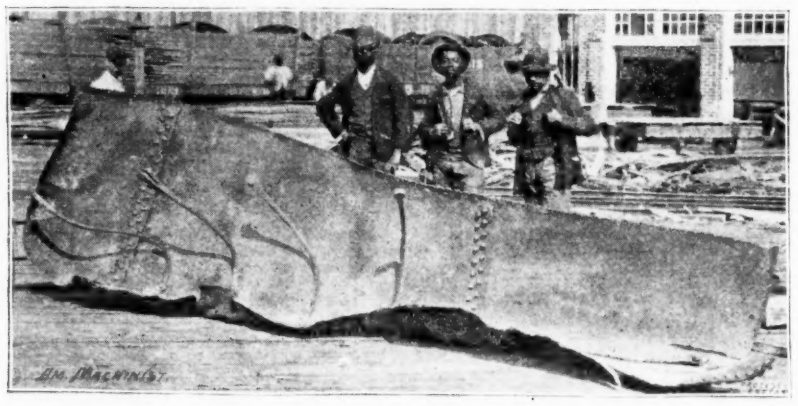
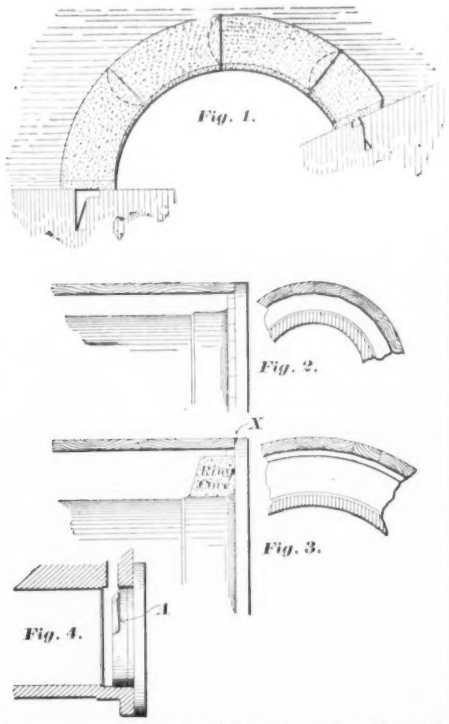


Fig. 9.

Fig. 10.

On some castings the stock allowed on the cope side of a casting should be more than on the drag side; for instance, a large crank disk, a Corliss cylinder, and many other jobs.



ITEMS FOR PATTERN MAKERS.—SEE PAGE 5.

Warner & Swasey, of Cleveland, Ohio, have secured the contract for remounting the telescope of the Naval Observatory at Washington—which means that all the present machinery of the telescope is to be discarded and replaced by the latest designs of Warner & Swasey. They are also to put in the elevating floor, dome, etc. This telescope, until recently, was the largest in the country, the glass and its mounting complete being furnished by Alvin Clark & Sons. The glass is entirely satisfactory, as of course all Clark glasses are, and that is to be retained; all else is to be new.

LETTERS FROM PRACTICAL MEN.

Size of Drawing Paper.

Editor American Machinist:

Noticing the recent discussion in your columns regarding sizes for drawing paper, I will say that I never have had cause to regret the standards originally adopted by me and fully described a few years ago in an article published in your columns. The smallest size measures 4½″x6″, and is known as "Sheet A." The other sizes are geometrical multiples of this, viz., the B sheet 6″x9″; the C sheet 9″x12″; the D sheet 12″x18″; the E sheet 18″x24″; and the F sheet 24″x36″.

By this arrangement all the smaller sheets can be cut from the largest without waste, and the drawers in which they are kept divide up nicely to take the assorted sizes. The proportion of each size is about right in regard to its relative length and width, so that either a short or a long side can be taken for the top of the drawing, according to the proportions that the drawing itself happens to be in any given case. As before described I use a diagonal label printed in one corner, facing inward toward the center of the sheet, so that it can be read equally well with a long or short side at the top.

It seems to me that these sizes are preferable to the odd lot mentioned by Mr. Riggs in your issue of March 3d, where such numbers as 10½, 13, 17, 19½, 34, 39, etc., are included. It seems rather absurd in these days when paper can be purchased just as easily of one size as another, to use a lot of queer dimensions which are difficult to remember. Is it not more in accordance with common sense to make the larger sizes in whole feet as well as whole inches, and the smaller sizes, which are divisors thereof, measurable in halves and quarters of feet as well as in whole inches? I think the matter of "evening up" dimensions in drawing rooms has rarely the attention paid to it that it should have; and a good general rule is to avoid all odd and unusual numbers and fractional numbers wherever they are not necessary. As an aid to memory alone this principle is an exceedingly useful one. Two feet by a yard is certainly an easy size to remember and measure. By the system in question this size is a basis for all the others which cut from it as divisors thereof.

OBERLIN SMITH.

Hubs and Bosses on Patterns.

Editor American Machinist:

In your issue of February 25th, Mr. John M. Richardson gives his experience in making hubs and bosses for patterns where they are to be put on in halves. For the same reason that Mr. Cooper gives I am a little reluctant to abandon my own way. Neither can I adopt Mr. Cooper's system, as it is quite a difficult task to chuck two glued-up pieces on a screw chuck and hit the joint fair in the center, even if you bore a starting hole, as the screw is apt to lead off a little. My plan, and I find it accurate every time, is to chuck a piece of wood, turn it off true and center it, joint up and square the two halves I wish to use, and glue them on the wood face plate I have prepared, bringing the joint to the center mark, and proceed as Mr. R. and Mr. C. have stated.

Until I see a better method than Mr. R. or Mr. C. have advocated, I will not abandon my own little way.

TORONTO PATTERN-MAKER.

The Tool-post.

Editor American Machinist:

In March 10th issue of your valuable paper is an illustrated article on a new tool-post for use on the engine lathe.

In the year 1871 I made a small engine lathe which had a tool-post of absolutely the same construction. This lathe also has what I believe to be the first arrangement for changing from back geared to open belt driving, with one motion of the back gear lever; that is, the stop pin is thrown out of the front gear and cone with the same motion that throws out the back gear shaft. This lathe is now owned by the Waltham Emery Wheel Co., and is in daily use by them.

JOHN J. GRANT.

Proportion in Steam Engines.

Editor American Machinist:

In justice to the "stump tail" class of locomotives (18″x22″, so named by your correspondent, C. O. Sine, March 3), I will report some additional items of interest occurring under my personal observation. While they were no heavier on the drivers than the 16″x24″ and 16″x26″ were, they invariably, when in good trim, "got there" first without a miss; both classes received the same care and treatment.

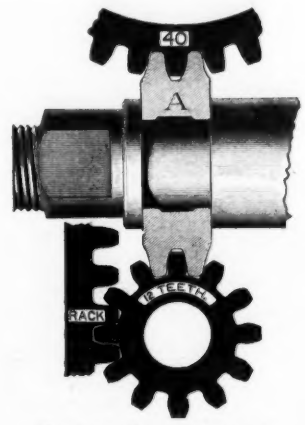
One day it was observed in the shop that the foreman was in a deep study—so much so that he was apparently absent-minded for a time; later on all became clear that his absorbing thought was a device he had in mind to attach to the "stump tail's" pop valve; to this device was attached a rod connecting it into the cab; on this rod, having a handle, was a flat space in which were cut several notches; these were occasionally "caught on" by the engineers to save a surplus pound or so of steam. It was an additional "catch on" which I had not got to in my former communications. They saved some of their wind for service—the others blowed it off; moral: a slight increase of boiler pressure, saved inside of safe limits, gave much more power per pound of coal burnt on the larger diameter of cylinder than it did on a small difference in length of crank.

By the way, the "stump tail" had a first-class method of taking steam from the boiler to the cylinders, better than many of the other machines of then and now do; they had a copper "dry pipe," the entire length of the boiler, suspended to its upper side. On the top side of this pipe there was a multitude of small holes drilled so as to take steam from the entire length of the boiler, instead of from one end in a dome. Another good feature was that their throttle valve was in the "front end," instead of in the dome at the rear end; they carried their water very much better than the ordinary locomotives did then or do now.

Mr. Sine has already admitted some of his errors; and if he will listen I will show him some more, which he made in article, March 3.

He tells us that a 68-inch wheel makes 291 revolutions per mile; try again, Mr. Sine; by this method, 68″ × 3.14 = 213.5″; 5,280 feet = 1 mile × 12″ = 63,360″ in 1 mile; 63,360 ÷ 213.5 = 296.7 revolutions of a 68 inch wheel in 1 mile.

He says also that if he can prove that a locomotive 16″x26″x60″ wheel uses more cubic inches of steam in running a mile than one 18″x22″x68″ wheel does, then it is a strong reason why it will pull the most load; "run slow at this point", Mr. Sine; dangerous for long stroke machines. However I may say this, that, though both classes of engines carried approximately the same steam pressure in boiler, and the "stump tails" used 55 cubic feet less of live steam per mile (cut-off ⅓ stroke) than the others, "they caught on" to the rail, enabling them to take nearly 25 per cent. more load and make time with it.



DUPLEX GEAR CUTTERS.

I ought to have said ere this that there are features in the operation of locomotives on rails, by steam power, which are not found in the ordinary stationary engine, and I ought to have said that the rules of horse-power computation alone would not wholly represent the ability of any class of locomotives in comparison to some other type of locomotive. But I am also decidedly in favor of a generous diameter of cylinder in proportion to the length of stroke of stationary engines, other items being properly considered also.

In a former communication I referred to the experience of a railway which learned that larger diameter of cylinder in proportion to length of crank than was formerly used had more business in it, and modified their 16″x26″x60″ wheel freight engine; I don't think it amiss to say that the new modification was in fact a new production—a result of the facts learned by the action of the 18″x22″x68″ wheel passenger engine. Those were the years when the "Moguls" were beginning to come into use as a freight engine; a certain locomotive company thought to convince the "old man" that their engines would do more service than his did with the same fuel; they told him that they would convince him by an actual test in competition with his modified freight engine and one of their Moguls having three pair of 56″ wheels connected. The railway company's engines also had 56″ wheel, two pair connected; the Mogul had cylinders 17 x26″ with nearly the entire weight of engine on drivers. The road's engines were very much lighter on the drivers than the Moguls; their cylinders were 18″x24″. Several ran in competition with the Mogul, and every precaution was used to insure a fair test. The locomotive company furnished their own best man as engineer; the place of test was a run between two cities involving grades and level runs—one grade was 60 feet to the mile. They ran thus for some time, but the road's engines never were once beaten; they always came out ahead—in amount of load drawn, in time, and in the amount of coal burnt. They had "business" in the generous diameter of cylinders; they were not all fire box as some of their competitors were; they had a good-sized tubular boiler, having a good generous "flue" area. Moral: if you would get the best results from any combination do not stint your motive-power. Remember that it is far easier to slow up on a good lively horse well-bridled and harnessed than it is to undertake to get speed out of a slow nag.

Mr. Sine asks, among other things, for me to "give an ideal locomotive for any branch of service" I will say this: that one type alone is undoubtedly out of the question for every branch of service, economy and result considered. I will say to him that I have in plans "brewing" a triple-expansion freight engine. "All aboard" for the best ideas on this or any other subject.

FRANCIS W. CLOUGH.

Duplex Gear Cutters.

The accompanying illustration represents a type of gear cutters which has been developed by Mr. R. M. Clough, of Tolland, Conn., who is now making them for the market, he having been making another but similar form of cutter for some years.

The distinguishing feature of the original cutter was that it cut both sides of a given tooth at each cut, thus making all teeth of uniform shape for a given pitch, regardless of the size of the gear, the spaces between the teeth showing all the variation due to differences in diameter, instead of the teeth.

In the present form the cutters are so made that the faces do not vary in different sized gears, while the flanks do vary, according to the number of teeth in the gear, all this being accomplished by a single duplex cutter of the proper pitch. An inspection of the engraving will show how the cutters work, the 40-tooth gear above the cutter having its teeth formed entirely by the inner faces of the cutter, while the 12-tooth pinion below has the faces of its teeth formed by the inner sides of the cutter and the flanks formed by the outer sides as shown. The result is, that one cutter, which may be made either solid or in two parts, cuts an interchangeable train from a twelve tooth pinion to a rack of the same pitch, the form of the tooth being either involute or epicycloidal as may be desired.

Improved Die for Punching Machines.

This represents a very convenient way for holding dies in punching machines, which will save much time and trouble in changing from one size to another.

It consists in forming a bevel shoulder at the base of the die, and using a screw coupling, having a similar shoulder, which holds the die firmly to its seat, and always in the center.

Punches have been held in this way for some time, and by fitting a screw coupling to the die seat, the die and punch will always come in line, and the time in changing will be much less than by the old way of setting the die to suit the punch every time a change is made.

The Coal Miners' Strike in Britain.

At the present writing it is estimated that more than half a million men are out of work from the great coal strike in Britain. Between 300,000 and 400,000 of these are miners, and the others are those thrown out of employment through lack of coal to operate the establishments in which they were employed. If the strike continues the number of the latter will be largely increased.

The cause of the strike appears to be an intention on the part of the mine owners to accumulate large stocks of coal so as to reduce wages.

Of the wisdom or unwisdom on the part of the miners in quitting work for the reason named, correct judgment cannot be formed at this distance. Besides the relations between labor and capital are not the same in Britain as they are here.

Strikes may be necessary sometimes, but this very necessity of settling differences by such barbarous means seems to indicate something fundamentally wrong in society. The miners are, no doubt, justified in trying to keep their wages at the living point, but it is unfortunnte that in doing so they cause suffering to those in different branches of work; unfortunate, but not necessarily wrong.

But if there is blame in the matter it may, for all that can now be seen, quite as likely be chargeable to the mine owners as to the miners.

As we before said, it is not possible to judge of the merits of the case, and probably never will be. The thing to be hoped for is that the occasion for strikes will soon be a thing of the past.

Radial Drill.

The accompanying illustration is of a new radial drill which has recently been brought out by the Bickford Drill Co., Cincinnati, Ohio.

To a heavy ribbed bed-plate is attached a fixed column which extends to the top of the machine, the outer or rotating column to which the arm is fitted turning upon this fixed column upon bearings at the top and bottom. This of course makes a heavy rigid construction, since, when the three clamping bolts are tightened, the outer column has all the rigidity of the inner column, which is permanently fixed to the bed, aside from the fact that the column is really a double one from top to bottom.

Under the flange at the bottom of the outer column there is a series of 12 antifriction rollers upon which the weight of the column and arm is borne, and which enable the arm to be turned to any desired position very easily.

The arm is of the box form, strongly braced, and is raised or lowered by power. The machine is driven from the cone-pulley seen at the back and by bevel gears driving a vertical shaft which passes up through the center of the column. The gearing is made sufficiently heavy and powerful for the heaviest drilling or boring. The spindle is counter-weighted, has a powerful automatic feed and an improved quick return. All hand wheels, levers, etc., used in operating the machine are placed in the most convenient position. The box table shown accompanies the machine, and when desired a tilting table is furnished instead. The machine is built in three sizes, drilling to the center of 8, 10 and 11 foot circles.

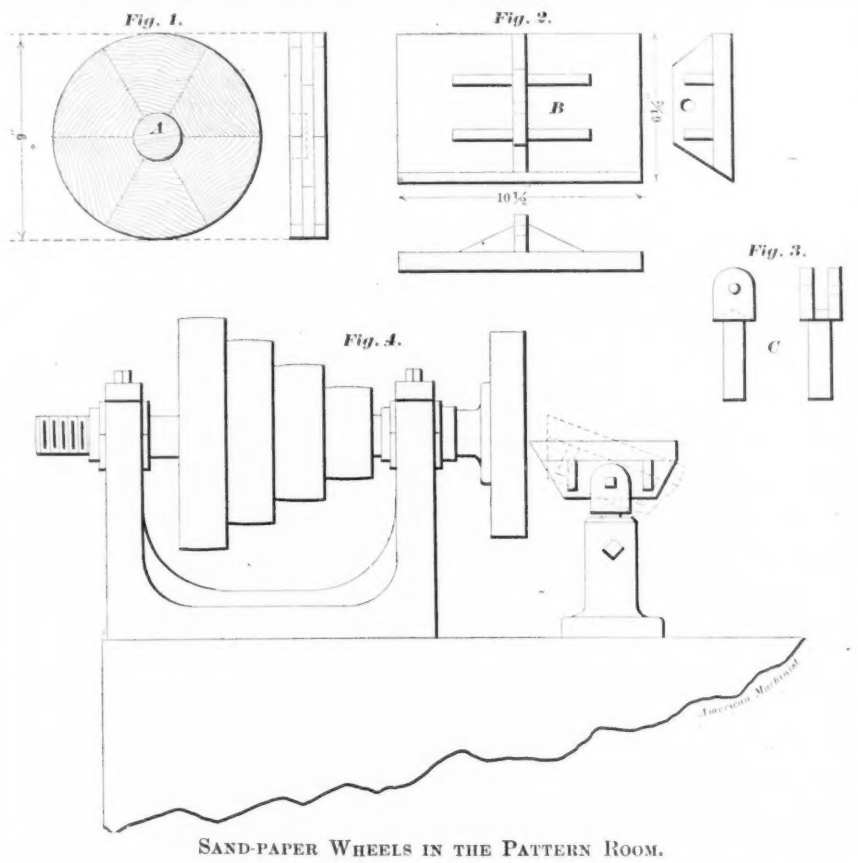
There has been a decision of the Ohio Supreme Court adverse to the Standard Oil Company, but of course, nobody expects the company to go out of business on account of it. The decision may possibly cause the managers of the monopoly some little trouble, but its grip upon the oil business will probably be as firm as ever.

It is said that during the year 1891 the Pennsylvania Railroad Company has expended for construction, equipment and real estate nearly seven and one-half million dollars. More than 39,000 tons of steel rails and about 1,500,000 ties helped to swell the account.

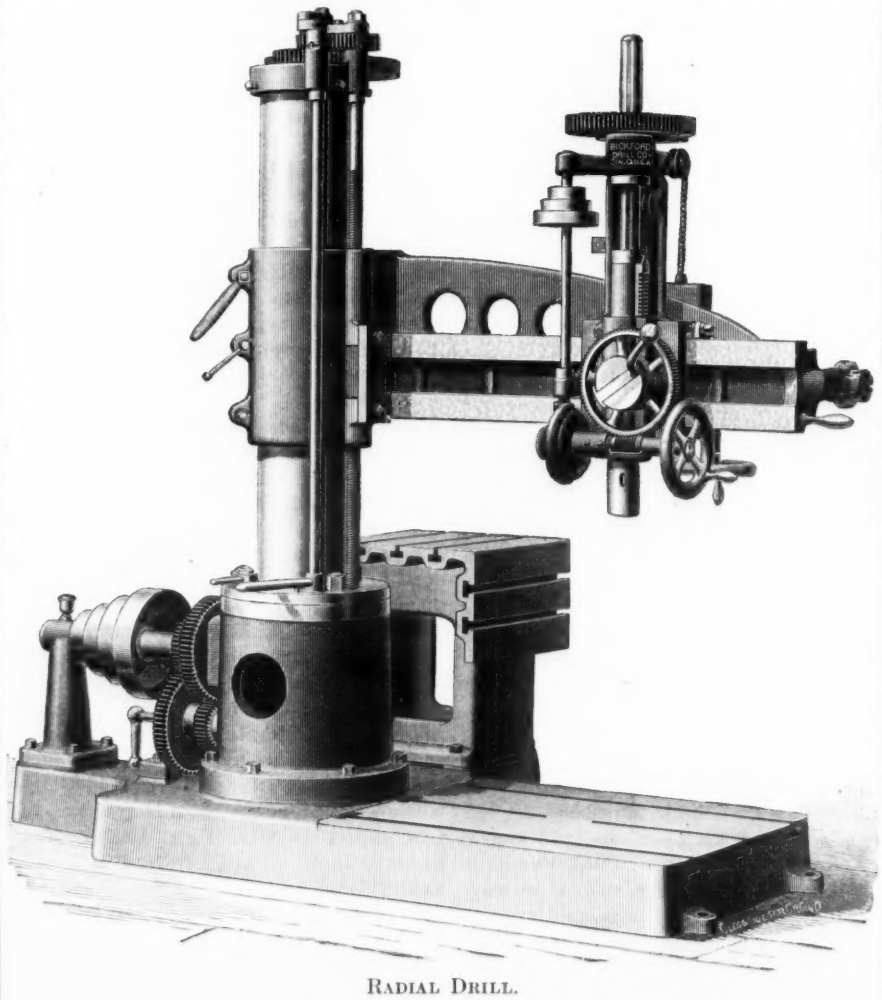
Sand-paper Wheels in the Pattern Room.

BY JOHN M. RICHARDSON.

The use of the sand-paper wheel may not be an "untrodden path," as it were, in all pattern shops, but still I believe it to be in a great number. Pattern-makers who have tried them and found them unsatisfactory may perhaps have pronounced them so from the following causes: namely, the warping of the wheel, and the lack of a rest on which to hold the work. It is almost impossible to make a wheel from one piece and not have it change its shape; for when the sand-paper is stretched over it and becomes thoroughly dry, it has a remarkable faculty of pulling the wheel over with it, and with a wheel of this description it is an utter impossibility to grind a perfectly flat surface. Even with a true wheel, it requires skill and practice to obtain an even surface, unless a rest is used on which to hold the work; for with nothing to support the piece, it will nine times out of ten get ground off more on the edges than it does in the middle, and this feature especially unfits it for pattern making, for it impairs the draft, and if sent to the foundry in this condition, it will most likely cause the molder to use language not at all complimentary to the pattern-maker. I shall attempt in this letter to describe the construction and use of the sand-paper wheel, together with an adjustable rest on which to hold the work, which will give the most satisfactory results finishing a variety of work directly from the band saw, without the intervening process of the spoke-shave, and saving the somewhat slow and tedious operation of hand sand-papering, also doing the work in a fraction of the time required by the ordinary method. As common sand-paper comes in sheets 9"x11", a good size for a small wheel is 9" diameter and 1½" thick, and should be made as in Fig. 1, being glued up in three layers of segments (or sectors more properly in this case). After the last layer is on, turn in a place as shown at *A*, about ¼" deep and 2" diameter, and fit in a piece of hard wood. The object of this is so that the wheel can be used on an ordinary screw chuck, and put on or taken off in a moment, and at the same time have the wear caused by the spur as little as possible. After this face has been trued off, it must be reversed and attached to the chuck on which it is to be used, and the front face and edge finished. Now apply the sand-paper, being careful to avoid lumps or blisters underneath it, which will cause it to do poor work. Figs. 2 and 3 show the two parts of the adjustable rest. *B* represents the table, and has a strip glued across the middle, strengthened by two ribs on each side. The strip serves as the tongue for the portion of the joint shown at *C*. They should be fastened together either with a screw or small bolt, which must be sufficiently tight not to slip while being used. The part shown at *C* should be made from hard wood, and the straight portion turned to fit the hole in the rest-holder belonging to the lathe. Fig. 4 shows both the wheel and rest in the lathe ready for use, and the dotted lines represent the manner of elevating the table for sand-papering on a bevel. This feature is very useful in making slight draft on the side of the pattern also. While this device will not be as rigid as one made of iron, still it answers very well indeed, and certainly has this good feature about it, that it can be made by any pattern-maker in a short time with but little trouble.



SAND-PAPER WHEELS IN THE PATTERN ROOM.



RADIAL DRILL.

It seems to us that there are altogether too many books published that have no title placed upon the back of the cover, where it can be seen when the book is upon the library or book-case shelf. No book ought, it seems to us, to be considered too thin to be supplied with this convenience, for the man who wishes to economize time and save himself considerable vexation must deface such books by pasting titles upon the backs. It may be all right for books read by people who have plenty of time to spare, but engineers and mechanics when they have occasion to refer to a book want to place their hands upon it without unnecessary delay, and this they cannot do when a number of books of about the same general appearance are on the shelves without any means of identifying them until taken down. Let every book for mechanics have a title on the back of the cover.

Mrs. Gumpps—"You remember the last time you drank too much, and was so awfully sick you put all your money in my name, and made me promise that if you ever took another drink I'd put you right under the Keeley cure." Mr. Gumpps—"Yes, my dear." "Well you were drinking again yesterday, and so I went right down to Catchem & Cheatem's and invested the money in Keeley stock." "Stock?" "Yes, Keeley motor stock, you know. They said all you had to do was not to take another drink till the motor began to mote, and you'd be cured."—*New York Weekly.*

The latest wreck on the Hudson River Railroad, so far as known at this time, came about through the collision of two freight trains at Yonkers, and a short distance beyond the extension of the block system. Fortunately none of the train men were injured. Outgoing trains were delayed several hours. As usual, after an accident, the New York Central management are going to put the block system along its lines at once.

The train accidents for the month of January show 120 collisions, 117 derailments and 12 other accidents, a total of 249, in which 61 persons were killed and 268 injured. One hundred and nine of these accidents were in the passenger service, in which 8 passengers were killed and 147 injured, the balance of fatalities and injuries being among railroad employes.

The *St. James Gazette* thinks Englishmen will feel a touch of shame at the fact that the grants to promote British interests at the Chicago fair amount to only £25,000.

AMERICAN MACHINIST

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NEW YORK, MARCH 24, 1892.

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Change of Location.

On May 1st, the AMERICAN MACHINIST offices will be moved about two blocks west from their present location to the new *Mail and Express* building, which fronts on Broadway, at No. 203, and on Fulton street, numbers 164–8. We shall then have increased room and every convenience and facility for carrying on our work.

No Mystery Here.

The photographs which are reproduced on pages 4 and 5 of this issue tell their story to the experienced engineer as plainly as any story can be told. No new lesson is to be learned from them, for the lesson they teach has been taught many times before. It is well known that there is no safe plan of arranging boilers other than by placing directly upon each boiler a reliable safety valve and steam gauge, with no means whatever for shutting off communication between the valves and the boilers. For if such means are provided for shutting off communication between safety valves and the boilers, experience has shown over and over again that the time will come when steam will be raised with communication shut off.

No one will ever be able to tell, probably, why the valves in this case were closed. It is, of course, probable, though not certain, that the engineer or his fireman closed them during the washing out process, with the intention of opening them again before leaving; but for what purpose they may have been closed, or, having been closed, why they were not opened in time to avert the terrible calamity which followed, will never be known in all probability.

We cannot but think that, generally speaking, though not necessarily so in every case, the builders of boilers are most to blame for such violations of what is well known to be safe practice. Every manufacturer of boilers should be at least reasonably well acquainted with the causes of wrecked boilers, and should insist upon putting them in place, or having them put in place in such a way as to give reasonable security. We do not know who in this case is responsible for the fatal arrangement, though in this case it seems unlikely to have been the builders of the boilers.

No boiler inspection and insurance company with whose methods we are acquainted would have considered for one moment a proposition to write a policy upon those boilers until the valves had been differently arranged. The coroner's verdict is a typical one, and in this case is seen to have been nothing more than the merest farce.

Mechanics and Machines.

Our contributor, Mr. A. D. Pentz, in commencing an article a week or two ago expressed his belief, not unmixed with regret, that the time seemed to be coming when the only place in which real mechanics would be called for would be in the toolrooms of manufacturing establishments, all other work connected with machinery being done by automatic or other machines requiring little skill for its manipulation.

Another machinist, in a personal letter speaking of our remarks concerning the limitations of molding machines, says: "What you say is true of all trades, and notably so in the machine shop. The turret lathe and milling machine have robbed the old-time 'jour.' of his glory, and put him in the same relation to his craft that the molder will bear when molding machines are more generally adopted. It is such machines that really take the more difficult work and reduce it to the level of the unskilled."

Now we must respectfully dissent from these views. We do not at all agree that if the "old-time jour." has been robbed of any of his glory, the turret machine or the milling machine have had anything whatever to do with the robbery.

We believe it can be conclusively shown, and in fact will appear plainly to any one who really looks about him, that these machines have in the main done work which would not have been done at all without them; or, when this is not the case, they have done work that is little more than mere drudgery, and which the "old-time jour." or any other mechanic is fortunate in being relieved of, so that he may devote himself to better things. Turret machines and milling machines have been in use for years in some shops very extensively, and in the very shops in which they are most liberally used there will usually be found the most skillful mechanics, and often the largest proportion of them to the total number of men employed.

It is safe to say that the sewing-machine business as we know it to-day would be unknown were it not for screw machines, milling machines and jigs. Without these, either skilled men would have to be employed to *build* sewing machines, or unskilled men would have to be trained to do some certain one thing and nothing else. The first plan would result in prohibitive prices for sewing machines, and the industry would employ far less skilled mechanics than have been and are still required, while with the second plan prices would also be much higher than now, and certainly fewer real mechanics would be required.

No real mechanic wants to spend his days in making a certain small screw or other part for a sewing machine, and no real molder ought to wish to spend his days in making sewing-machine arms or treadles.

All such work when it comes to be done in sufficient quantities to warrant the employment of special machines and tools becomes mere drudgery—the repetition of the same thing over and over again, and mechanics, genuine mechanics, are well rid of it. Moreover, the more of such work there is done by machinery the more demand there will be for the work of the real mechanic, for the two things necessarily go together, and it is our confident belief that, so long as machinery is used at all, there will be a demand for good mechanics—good machinists and good molders to make that part of the work which machines never can do—that part for which brains are required. When no new machinery is being invented, and none can be, then the demand for good mechanics may cease; but when that time comes, the demand for pretty much every other kind of men will cease as well.

The officers of the companies which have recently been combined for the purpose of controlling the anthracite coal business seem to be having considerable difficulty in satisfactorily explaining to stockholders and smaller producers of coal how they are to receive more money from the public, and at the same time explaining to the public or its representatives how the price of coal is not to be increased.

The importance of the combination is causing it to attract a great deal of attention, and it may easily yet happen that this combination will be the cause of more harm being done to "vested rights"—to a greater loss of respect for property rights, than could all the efforts of all the anarchists in the country.

The spirit which is being shown in the treatment of this question indicates clearly that the people have made up their minds not to endure combinations by which the prices of necessities are materially increased, and those who are forming such combinations are either strangely ignorant of the temper of the public on this question, or they expect to form their combinations, make some money out of them, and then unload before the full force of the storm breaks upon them. Some of these men may be right in their calculations, but some of them, on the other hand, may find themselves to be mistaken.

The latest decisions of the courts seem to indicate that the trusts and combinations will have to abandon another position, *i. e.*, that a corporate charter may be taken out to cover several different companies, and thus a combination effected under the sanction of the law. The courts have recently decided that such corporations are illegal and void, and that contracts made by or with them are not binding.

Literary Notes.

FORMULAS IN GEARING WITH PRACTICAL SUGGESTIONS.

This is a book in which all those things which a draftsman or designer usually wishes to know regarding gears can be found in convenient form, excepting that which relates to the transmission of power or the strength of gearing. This is for the draftsman and engineer what the "Practical Treatise on Gearing" is to the shop man, and in it will be found, in the shape of formulas and rules, all that is required for the proper delineation of gear wheels, with the exception noted above. The higher mathematics are not made use of, the book being easily within the comprehension of all who are acquainted with ordinary algebra and elements of trigonometry, or are willing to study these branches a little. The rules and formulas given are those that have been in use in the drafting-room of the publishers, the Brown & Sharpe Mfg. Company, and consequently are those and those only that have been found to be practical and useful and adapted to every-day use in the drafting-room and shop. The book is liberally embellished with engravings, and every subject taken up is made as plain as its nature and the scope of the treatment will admit of. All the commonly used kinds of gearing are discussed and the principles governing their construction explained. There are also tables giving all the dimensions, tooth parts, angles, etc. There is a chapter on gear patterns, one on bevel gears and another on bevel gear cutters; one giving directions for cutting bevel gears with rotary cutters. One chapter deals with indexing any whole or fractional number, and another with gearing lathes for screw cutting. The printing, engravings and binding are excellent, and the book will undoubtedly be considered by practical men a valuable addition to the literature of the subject. It is published by the Brown & Sharpe Mfg. Company, Providence, R. I. Cloth, $2.

Questions and Answers.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(113) R. G., Huntington, W. Va., writes: I would like to learn the art of making blue prints. How should I go about it? There is no teacher in this place. *A.*—See answer to Question 117, in our issue of March 5, 1891.

(114) C. W. M., Westfield, Mass., writes: Kindly inform me through your columns of a good composition for filling up holes in castings. *A.*—Lead, 9; antimony, 2; bismuth, 1 part, is considered to be a good mixture for the purpose; it expands in cooling.

(115) I. L. M., Waterbury, Conn., writes: Kindly inform me through your columns if there is any book published that would be of practical use in the way of instructing a young man just starting to learn die-sinking and engraving. *A.*—We do not know of any book treating on these subjects.

(116) Euclid, Mechanic Falls, Me., writes: Kindly give me the safe pressure for an upright steel boiler 38 inches diameter; shell, $\frac{5}{16}$ inch thick; longitudinal seams double riveted; rivets, $\frac{3}{4}$ of an inch diameter. *A.*—If the sheets are in nowise injured, and the workmanship is good, you may carry 185 pounds per square inch.

(117) J. W. R., Chicago, Ill., writes: I would like you to give me some information which I have not been able to find anywhere so far. It is the temperature of the gases and products of combustion in a cupola of say 24 inches diameter, at a point 3 feet above the melting point, when the cupola is running at its best. *A.*—We have no figures at hand which give the temperature at

different heights in the cupola. The only way you can determine this is by means of a pyrometer.

(118) W. H. W., New Haven, Conn., writes: In reply to Question 427 in your issue of October 1, 1891, you say that the water cannot be returned to boiler without a pump, trap or an injector. A few blocks from where I am located, there is a battery of six boilers used for heating purposes. There is no pump, trap or injector used to return the water to them. How do you reconcile your theory with this practice? *A.*—We overlooked the gravity system; we thank you for drawing our attention to it.

(119) S. W., Baltimore, Md., asks: What is the composition of gun metal? *A.*—Gun metal is an alloy of copper and tin, very commonly a small amount of zinc is added; this makes the alloy mix better, and lean to the character of brass by increasing the malleability without materially reducing the hardness. Lead in small quantities improves the ductility of gun metal, but at the expense of its hardness and color; it is seldom added. The proportions of copper and tin vary, and may be as follows: Copper, 87.75; tin, 9.75; zinc, 2.5. Copper, 91; tin, 7; zinc, 2. Copper, 85; tin, 5; zinc, 10. Copper, 83; tin, 2; zinc, 15. Copper, 92 5; tin, 5; zinc, 2.5. 2. Who are the manufacturers of that kind of castings? *A.*—They can be made in any first class brass foundry.

(120) J. D., Bluefield, W. Va., writes: Please answer the following question: An engineer's pocket-book gives the following formula: $X = S\left(1 - \frac{2L + l^2}{T}\right)$, in which X is the distance traveled by the piston before steam is cut off; S, stroke of piston; L, lap in inches; l, lead in inches; T, travel of slide valve. What I want to know is, where does the author get his 1 (one) from? 2. Also will this rule give correct cut-off for a whole revolution? I claim not, except by making a little alteration to slide valve by deducting from or adding to the lap. *A.*—The formula is not correct. Locomotive builders make the lap at each end of the valve equal; for obtaining an equal cut-off in the forward and return stroke of the piston, the saddle pin on the link, and the lifting shaft with correct length of arms must be correctly located.

(121) F. W. S., Orange Valley, N. J., writes: Kindly explain the meaning of the term *vis viva*. I have examined all reference books in my possession and fail to find a satisfactory definition. *A.*—The expression *vis viva* simply means kinetic energy or living force of a body, or the quantity of work that has been stored up in a moving body by virtue of the action of a force, all of which will be given out whilst the body is coming to rest. Or we may say that the *vis viva* is the quantity of work which the stored up force in a body at any given instant could perform, if left to itself, without afterward receiving any additional force. The quantity of work that a moving body is capable of performing whilst coming to rest is represented by the symbolic expression $\frac{1}{2} m v^2$, in which m denotes the mass of the body, and v its velocity in feet per second. The expression *vis viva* is seldom used by modern writers.

(122) C. D. D., Providence, R. I., writes Kindly answer the following question. In one of your back numbers (I think it was in 1888) in answer to a question relating to the horse power of shafting, you give the following formula:

$$H = \frac{D^3 \times R}{90}.$$

In your answer to Question 524 in your issue of December 3, 1891, you give $H = \frac{D^3 \times 3}{125}$. Now what I wish to know is, which formula is right, or are they both right under different conditions? *A.*—The second formula to which you refer is applicable to head shafts supported by bearings close to each side of the main pulley or gear, so as to wholly guard against the transverse strain. The first formula is applicable to line shafting, from which power is taken at intervals, bearings 8 feet apart. See answer to Question 57 in our issue of February 4, current volume. It should, however, be stated that all engineers do not use the same divisors as given above, as authorities differ on this subject; but we believe that the foregoing formulas will give good and safe results in the majority of cases.

(123) F. J. N., Brooklyn, N. Y., writes: Please answer the following: I have 50 pieces 5 inches long $\frac{1}{4}$ inch square; they stand on their ends on a table. I wish to know how fast they will fall; they are forced off the edge of the table, and each is to follow its former one as close as it is possible. Scientific men teach us that the average velocity of a falling body is 32 feet per second; but how long will it take to fall through the first 5 inches? *A.*—You are slightly mistaken in saying that the average velocity of a falling body is 32 feet per second; 32 feet, or more correctly $32\frac{1}{6}$ feet per second is the acceleration due to gravity. The time it takes for a body to fall in vacuum through a given distance is found by the following formula: $t = \sqrt{\frac{2h}{g}}$, in which t denotes the time in seconds, h the height in feet through which the body falls, g the acceleration due to gravity = 32.16 feet per second. It is evident that each piece must fall through 5 inches = .416 feet before the next one can commence its fall. Substituting for the symbols their values, we have $t = \sqrt{\frac{2 \times .416}{32.16}} = .16$ of a second required for each piece to fall through 5 inches; consequently the time required to force all the pieces off the table will be $(50 - 1) \times .16 = 7.84$ seconds.

(124) F. E., Schenectady, N. Y., writes: Please inform me through your columns how many foot-pounds of work will be necessary in actual practice to compress a piece of Bessemer steel at a forging heat of say 3x5x1 inch initial size to a size of say 4 x$7\frac{1}{2}$x$\frac{1}{2}$ inch. *A.*—It is impossible to answer your question with a degree of exactness, since there is no reliable data at hand upon which to base the calculation. The strength of heated metals has long been a subject of debate, and has not yet been satisfactorily settled by experiment. The term forging heat is also very indefinite. Assuming that under the conditions it takes 50 tons per square inch to compress the metal, then since there are 3x5 = 15 square inches of metal to compress, it will require $15 \times 50 = 750$ tons to start compression, and if this pressure does not change during the time the metal is reduced to a thickness of half inch, then the work performed will be equal to $\frac{1}{32} \times 750 = 31.2$ foot tons. Of course this is only a rough approximation, but it may serve as a guide in designing. 2. How many foot-pounds of work will be required to punch an oval hole say 3x$\frac{3}{4}$ into a piece of Bessemer steel say 4 inches deep at a forging heat? *A.*—Assuming the circumference of the hole to be 6.5 inches, its depth 4 inches, then the area which will resist shearing will be 26 square inches. If now the shearing resistance is 25 tons per square inch, then it will require $26 \times 25 = 650$ tons to start shearing; at the depth of 4 inches this force will be 0, hence the average force will be $\frac{650}{2} = 325$ tons, and the work done will be $\frac{4}{12} \times 325 = 108.3$ foot tons.

(125) C. F., Guttenberg, Iowa, writes: Kindly give us your opinion in regard to the following: There is an engine for sale, for the reason that it is not economical enough, and I think it is too large. The plant at present requires no more than 45 H. P. The engine has a throttling governor. With 60 pounds boiler pressure, cutting off at $\frac{1}{4}$ stroke and making 62 turns per minute (formerly 85) uses about 1 ton of water per hour. The engine is rated at 150 horse-power; cylinder 20x30 inches, rocking valve, variable cut-off, independent exhaust; Gardner governor; 18 foot fly-wheel weighing 8 tons; size of main shaft 6 feet long, 8 inches diameter coupled to a shaft 10 feet long, 7 inches diameter, and to another 14 feet by $5\frac{1}{2}$ inches diameter; one 6 feet by 20 inch split pulley. The engine is very near as good as new; it has never been run to exceed more than one-half of its capacity. It is to be sold to make room for lighter power for a new milling process. What I should like to know is whether any gain could be derived by putting on say an 11 inch cylinder with the same stroke, using steam at 100 pounds boiler pressure and using an automatic governor? The shaft and fly-wheel are larger than need be, producing unnecessary friction, and it is this part that troubles me. Considering that the present engine cannot be disposed of, and in order to make a change, it would have to be taken out; also foundation, and a new foundation made, a new engine put in. It strikes me that the above might be worth the cost. If not asking too much, please state size of cylinder, ports, and size of slide valve you would think proper. *A.*—We do not favor putting a small cylinder in place of the large one, as the reduction of power is too great. It is difficult to advise you what size of engine to adopt, as we know nothing of the surrounding circumstances or the particular duty required of the engine. If there is sufficient water supply, it may be advisable to use a condensing engine. If a non-condensing engine is required and other circumstances will permit, we should use a 9$\frac{1}{2}$x12-inch engine running at a rate of 200 revolutions per minute; this will be amply large to furnish 45 horse power with the boiler pressure you mention. With an engine properly designed for the duty it has to perform the saving of fuel will soon pay for the extra expense in putting in a new engine, and the result will be far more satisfactory than changing the cylinders on the old engine. The space which may be gained by putting in a new one may be of considerable importance. For the size of engine mentioned we should make the steam ports 7 inches long by $\frac{1}{2}$ inch wide. If you decide to use an ordinary slide valve, you may find its dimensions by following the instructions given in our issue of May 1, page 5, 1890.

(126) A. F. M., Holyoke, Mass., writes: In your issue of October 29, 1891, I see a formula given for determining the thickness of cylinder walls, such as are used for hydraulic presses. Now, either I misunderstand the formula, or else it is of little use; for instance, you give an example: s = 3,000 pounds, safe tensile strength; p = 1,285 pounds, pressure per square inch; r = 4 inches, inside radius of cylinder; t = 3 inches, thickness of cylinder walls. For computing the thickness you have:

$$t = \frac{p \times r}{s - p} = \frac{1,286 \times 4}{3,000 - 1,286} = \frac{5.144}{1,714} = 3 \text{ inches.}$$

Now what I would say is, that a cylinder of the foregoing dimensions ought to safely withstand a pressure of double if not more than 1,286 pounds, and include a factor of safety for shock and jar. Further, if the formula given is trustworthy, how about the following case: Let s = 3,000 pounds, p = 3,000 pounds, r = 1.5, $t = x$. We have, then:

$$t = \frac{p \times r}{s - p} = \frac{3,000 \times 1.5}{3,000 - 3,000} = \frac{4,500}{0} = ?$$

It is well understood that when the pressure equals the safe tensile strength of the material it is impossible to construct a cylinder that will fill the requirements of the case. I have built several cylinders to work under a pressure varying from 2,500 to 3,200 pounds, with the following sizes: Diameter of cylinder inside, 3 inches; thickness of walls, $3\frac{1}{2}$ inches; material, ordinary cast-iron. I should have no great fear of guaranteeing the same cylinder for 4,000 pounds. The formula which I was guided by is one given by John W. Hill, and is $R = r\sqrt{\frac{T + P}{T - P}}$, in which R denotes the outside radius of cylinder, r inside radius of cylinder, T tensile strength = 16,500 pounds, P pressure per square inch. But from actual experience we have found that even this formula is excessive. I intended to say that the question asked by A. B. is one I have tried to settle myself many times, and I congratulated myself that I had succeeded, but when I saw your answer I am afraid I shall have to wait a while longer. The formula which I quote (J. W. Hill's) I know to be excessively "safe," commercially, from the fact that a company who do some considerable hydraulic work do not work up to his figures; in fact, not more than half the strength in some cases, and they have no trouble by presses failing. *A.*—The formula we have given in our issue of October 29, we believe to be a good one, and will give safe results which agree very closely with the results of the formula used in ordnance construction, as you will see by referring to the article treating on the stress in cylinders in our issue of February 4, current volume. In regard to the first question in which you obtain $\frac{4,500}{0}$, it may be stated that with the factor of safety as adopted in our formula, the figures show that the limit of safety has been reached, and it does not impair the value of the formula, no more than similar results will impair the value of the formula which you use as a guide; for instance, if you take the pressure equal to the tensile strength in your formula, as you have done in ours, you will have the same apparent quandary, but which really shows that a limit has been reached. Applying Mr. Hill's formula to the cylinders you have designed, then if we understand you correctly we have $R = 1.5\sqrt{\frac{16,500 + 3,200}{16,500 - 3,200}} =$ 1.8 inches very nearly for the outside radius, which leaves for the thickness of cylinder walls 1.8 — 1.5 = .3 of an inch, and yet you have made the cylinder walls $3\frac{1}{2}$ inches thick, which shows that in this case you have not been guided by that formula. Of course, you did perfectly right to increase the thickness as obtained by computation, because a tensile stress of 16,500 pounds per square inch is, or very nearly so, the ultimate strength of cast-iron, and allows practically nothing for a factor of safety. On the other hand, if you use the same tensile stress in the formula we have given, then the thickness of the cylinder walls which you have designed should have been

$$t = \frac{3,200 \times 1.5}{16,500 - 3,200} = .36 \text{ of an inch,}$$

which practically agrees with result obtained by your formula, and of course this thickness should not be adopted, because nothing is allowed for a factor of safety. The whole matter reduces itself to this question: What factor of safety shall we adopt? If we adopt 3,000 pounds per square inch of cast-iron for the safe tensile stress, then the factor of safety will be about 6. If your experience shows that a lower factor of safety can be used for your class of work, then do so.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Note the cat on page 20.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Ideal Drawing Stands. M. C. Hammett, Troy, N. Y.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

A. D. Pentz, Consulting. Tools, Elizabeth, N. J.

See Gage advertisement below.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

Gage Tool Co.'s Self Setting Plane does more and better work in less time. On trial. Vineland, N. J.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

For Foundrymen's Metallic Pattern Letters and Figures, send to Knight & Son, Seneca Falls, N. Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 8 Spruce St., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N. Y.

S. A. Smith, 23 S. Canal St., Chicago, Ill., is agent for Holbrook's new loaded rawhide mallets.

Send for sample pages of "Barrus Boiler Tests," to Gowing & Co., Mason Building, Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

For the Latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson St., Chicago, Ill.

Save small iron from foundry refuse. It pays Use the Woodruff Pat. Separating Machine, Audubon Machine Works, New Haven, Conn.

S. W. Card & Co., Mansfield, Mass., are putting on the market a new line of stocks and dies, with their patent adjustable dies and guide. S. A. Smith, 23 S. Canal Street, Chicago, Ill., western agent.

25", 32", 37", 42" — "Only Drill Press built on 'Ko-rekt' principles, Even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Complete treatise on Screws and Screw-making, with clear and concise explanation of the methods; 95 illustrations. Price, $1.25 postpaid. E. & F. N. Spon, 12 Cortlandt St., N. Y.

Patent Soliciting of High Class.
D. Walter Brown, Counsel in Patent Cases.
31 Nassau street, New York.
Send for Brief History of Patent Legislation.

What do you want to buy? We will send without cost to you, catalogues, price lists, and information concerning anything you wish. Paret, Willey & Co., 265 Broadway, N. Y.

The Brown & Sharpe Mfg. Co., Providence, R. I., have just published a book, entitled "Formulas in Gearing," which supplements their "Practical Treatise on Gearing," and furnishes simple formulas for solving the problems that occur in making gears. Price $2, postpaid.

De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

Cast-iron Mixtures.

BY S. BOLLAND.

I.

The following question was referred to me by the AMERICAN MACHINIST, "Will scrap mixed with pig iron produce sounder and cleaner castings than would result from the use of pig iron alone"?

An indefinite answer to a question of such importance would be disallowable and unjust, so I seize the opportunity presented in the question of giving my views upon the whole subject of mixing irons, out of which I hope the querist will be able to extract as much information as will serve his purpose.

It is the business of the iron founder to produce castings which will best meet all of the numerous demands—fineness combined with hardness, fineness combined with softness, strength to resist pressures and strains, etc.

He must also be able, by a judicious selection of different brands of iron, to produce mixtures which will meet the almost impossible demands created by faults in construction, as well as the countless conditions which, owing to the nature of the case, are imperative and can only be met successfully by correct mixtures.

Now, is it not true that these emergencies are met, in a great majority of cases, by the merest chance, and not until after great loss

has been sustained, from repeated experimenting, is success achieved? And, be it remembered, such success is, at best, only partial, for owing to the lack of correct data the whole experience must inevitably be repeated whenever the emergency again presents itself.

I would ask, what guide has the founder ever had ordinarily, other than the bare statement that No. 1 iron is all such as shows large crystals, smooth and bright, soft, almost to sponginess, in some cases, and that all such irons are to be chosen for use in the production of light castings; whilst No. 2 is to be recognized as being lighter in color, and to have smaller crystals than No. 1, eminently adapted for general work, machinery castings, etc.; and again, that No. 3 is all such iron as shows a greater density than No. 2, with a slight mottle in dicated, and that this latter is to be used for the heaviest work?

This, strange as it may seem, is about all that the average founder knows about cast iron; is it any wonder that so many blunders are made?

It is no uncommon thing to hear of some founder who has met with a difficulty, caused by a too free use of No. 1 iron, trying to overcome the same by making still further additions to his mixture of the same brand, this because of the generally accepted idea that No. 1 iron is the panacea for all evils of whatever nature.

Such a person, wise in his own conceit, would ridicule the idea of overcoming his difficulty by means directly opposite to those he was pursuing; nevertheless, such a course would, in all probability, be the only one to take if success is to be assured.

Not unfrequently, when I have failed to obtain a degree of softness which was satisfactory by the use of No. 1 irons, I have had no difficulty whatever when No. 2 has been substituted, and it has been no uncommon thing in my experience to discover that the scrap pile contained the most valuable stock in hand; in fact, I know of one foundry in particular where strictly assorted scrap is used almost exclusively, with very excellent results, but that is because of the superior knowledge of the foreman, who has devoted himself to the study of such matters.

It will not be out of place just here to relate an experience of my own which bears directly upon this subject.

Some years ago I was called upon to take charge of a foundry where they had been experiencing considerable trouble with their iron. Castings innumerable were being rejected owing to their extreme hardness, and it had become imperative that steps be taken to check, by some means, the enormous losses they were sustaining.

Close at hand was found a stack of No. 3 pig-iron which had long been voted useless; this was flanked by an unsightly mass of promiscuous scrap, which, under the circumstances, it was considered impossible to use. In addition to all this, I was shown another pile of scrap, remote from the foundry, which represented the accumulations of years, and footed up to the respectable sum of about 400 tons.

It was not long before I discovered what had caused this extraordinary waste, one chief cause being that the mixtures were arranged by one of the officials in the office, whose only claim to distinction in that line of business arose from the fact that he had, in some remote period of his life, held a position at a smelting furnace. His method was to take portions of the several brands either alone or in varying mixture, and make a crucible test of a very limited kind, and from such tests a formula was made out for the guidance of the foreman, with the result as above stated.

To overcome these evils recourse was had to very stringent measures; the services of the quondam mixer were dispensed with at once, and those of a metallurgical chemist engaged, by the aid of whom I was enabled, in six months, to use up every pound of this so called obnoxious iron, to the great satisfaction of my employer, from whom I received the highest encomiums.

I would here observe, that there was no "Scotch" or No. 1 irons used to effect this result; after a careful analysis had been made of all the irons on hand, and their natures distinctly noted, suitable mixtures for the various kinds of work were made, and all upon a strictly chemical basis, with astonishingly successful results.

The medium through which all this was accomplished was a brand of iron (on hand) which was exceedingly high in *silicon*, and it was the wonderful results produced by its agency on this occasion which changed all my cherished ideas in regard to mixing of metals on the old lines.

My firm conviction now is that the mixing of irons cannot be intelligently carried on unless *chemical analysis* forms the basis of procedure; and before attempting to give any absolute data for the guidance of others in the mixing of irons by this method, I would ask the reader to look to me, not as a master in these matters, but as a student who has just touched on the edge of a new truth and desires that others, equally interested, may share in the discovery.

Mr. Turner, demonstrator of chemistry, Mason College, says: "(1) Pure cast-iron—*i. e.*, iron and carbon only—even if obtainable, would not be the most suitable material for use in the foundry; (2) that cast-iron containing excessive amounts of other constituents is equally unsuitable for foundry purposes; (3) that the ill effects of one constituent can, at best, be only imperfectly neutralized by the addition of another constituent; (4) that there is a suitable proportion for each constituent present in cast-iron. This proportion depends upon the character of the product which is desired, and upon the proportion of other elements present; (5) that variations in the proportion of *silicon* afford a trustworthy and inexpensive means of producing a cast-iron of any required mechanical character which is possible with the material employed."

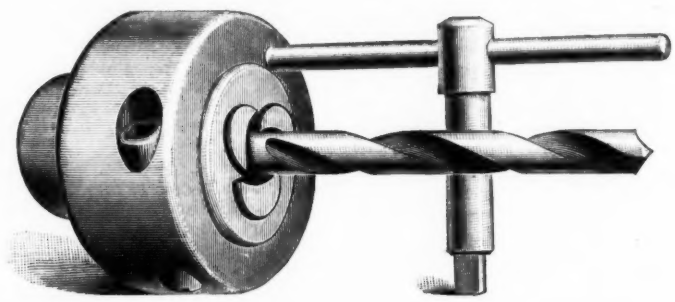
In support of the fifth clause, relating to *silicon*, we quote from William Kent, in American Machinist, February 20th, 1890, where he says that "Mr. Charles Wood claims for himself, assisted by Mr. Stead, the discovery that *silicon* had the power of reducing the combined carbon into uncombined carbon, or, in other words, to convert white iron into gray iron." Experiments made at numerous foundries in France had completely established the fact and confirmed the statements made by Mr. Wood.

The custom of purchasing irons by their fracture, Mr. Wood said, in order to obtain sound castings was a great mistake and must be abandoned. He admitted that hitherto it had been the only practical system known, and that founders in order to make soft castings had always gone to Scotch No. 1 or like rich brands to mix with other qualities in order to produce this result, but he had shown that the common-cast iron, such as mottled and white, could be reduced to any degree of softness by a proper mixture of silicon iron; and an iron founder by following this rule, *and studying analysis of the irons at his command*, could now produce in his cupola the exact quality of iron most suitable to his castings, instead of as hitherto depending upon special and expensive brands, which were often very uncertain in producing what was required, although the *fracture* might be all that was desired, whilst the only explanation was to be found in *analysis*.

Such evidence, coupled with personal observation and constant practice, forces us to the conclusion that a new era is dawning upon us in so far as relates to this subject, and already do we notice astonishing results from the adoption of the method of chemical analysis in the production of cast-iron car wheels. We quote from the same authority, who says: "Some years ago it was thought that only 'Hanging Rock' or 'Salisbury' cold blast charcoal irons were good enough for car wheels, and these irons brought very much higher prices than other irons. The chemists at length discovered that the peculiar characteristic was that they were lower in *silicon* than hot blast and coke irons, and reasoned therefrom: (1) that if other irons could be found having identical *analysis*, they would be equally good in quality; (2) that if the *silicon* in coke and other hot blast irons could be reduced to the same percentage that existed in these cold blast irons, either by partial blowing in a converter or by diluting the iron in the cupola with irons or steel that contained little or no *silicon* (such as steel rail ends), the same results would be found. Practical experiments demonstrated the truth of these theories, and now there is probably more iron used in making car wheels than the whole product of the 'Hanging Rock' and the 'Salisbury' districts, these irons no longer bringing the fancy prices, relatively, to other irons that they once did; irons formerly considered not good enough are now in demand for the purpose, and the cost of the iron used in a car wheel is greatly reduced.

"The time is probably not far distant when pig iron for foundry purposes will be bought and sold on *analysis*, just as iron for Bessemer and other steel now is, and the results will be stronger and cheaper castings, more certainty in quality of product, lower prices for fancy brands of iron sold on their old reputations, and higher prices for scrap, white iron, silver gray and other varieties hitherto undervalued."

In my next I shall attempt to give an account of some of the chemical substances found in irons of different kinds and how to combine them to obtain certain results.



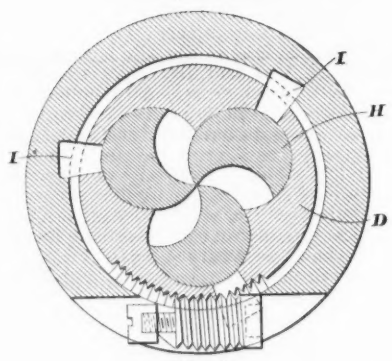


Fig. 2.

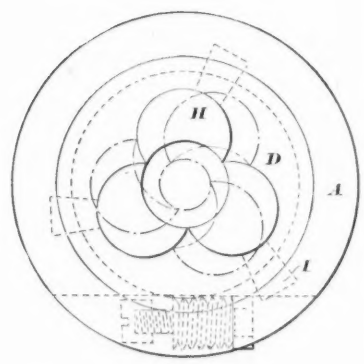


Fig. 3.

A New Drill Chuck

The extension of the Lehigh Valley Railroad line to Buffalo will call for a material increase in motive power and cars. Orders have been given by the company to the Baldwin Locomotive Works for twenty-five locomotives, and a large number of cars have been ordered. It is expected that the connections of the road between Jersey City and Buffalo will be completed by May 1.

A New Drill Chuck.

We illustrate herewith a drill chuck, which has recently been patented by Mr. Geo. W. Francis, 126 Carpenter street, Reading, Pa.

The chuck consists of an outer shell (*A*), within which there is a cylinder (*D*), which can be rotated by means of the worm and worm teeth shown, the latter being cut upon its periphery. This cylinder is bored longitudinally to receive the three hardened steel jaws (*H*), the form of these jaws being clearly indicated by the outline engravings. To each jaw there is attached a small arm or lever *I*, the end of which is held within a suitably formed recess in the outer shell, the effect of this being to rotate the jaws within the cylinder as the latter revolves, thus bringing the edges of the jaws together, as shown in Fig. 2, which is a cross-section of the chuck. Fig. 3 shows the jaws partly opened to receive a drill.

It will be noticed that the form and arrangement of the jaws is such that any resistance of the drill tends to tighten the jaws still more upon it, so that it may be said to be a self-gripping chuck, in which the gripping force is proportioned to the resistance encountered, and it has been shown by trial that the chuck is fully able to drive any drill within its capacity up to the full strength of the drill. A spring ring keeps the jaws in place at all times in whatever position they may be placed.

Personal.

Mr. Charles A. Clarke, of the old machinery firm of Hill, Clarke & Co., Boston—the firm having been established in 1853—will hereafter reside in Chicago, in which city he will manage the business of the firm's western branch, the firm having lately purchased the business heretofore carried on by A. J. Kirkwood & Co., at Nos. 12 and 14 S. Canal street, in that city. The Chicago branch will add the special lines of machine tools with which the eastern house has been so long and so widely identified. Mr. Clarke's business and social qualities can be depended upon to make him a useful and agreeable citizen of the World's Fair City.

Manufactures.

Work has begun at the Clay Working Machine Co., of Chattanooga, Tenn.

The city of Knoxville, Tenn., will spend during the year $125,000 for bridges.

The Fort Worth (Texas) Iron Works has increased its capital stock from $50,000 to $100,000.

The Blandon Rolling-mills, Reading, Pa., are to be operated, it is reported, by a new company.

An ice factory, with 50 tons daily capacity, will be built at Chattanooga, Tenn., by Brown & Rettig.

The Central Railway Co., Baltimore, Md., will build an electric power plant to operate its street railway.

The Chicago Insulated Wire Company have been incorporated, at Charles City, Iowa, with a capital of $300,000.

Kirkefer Bros. & Co. will erect a tin-plate plant at Milwaukee, Wis., with an annual capacity of 6,000 tons.

The American Axe Co. are fitting up the shop on the upper dam at Oakland, Me., preparatory to making scythes.

Knowlton Bros., of Watertown, N. Y., have been incorporated to manufacture pulp and paper. Capital, $1,000,000.

The Rome Cotton Tie Co., at Rome, Ga., will add new machinery and increase the number of its puddling furnaces.

It is stated that Messrs. Hackett & McKernon will erect an iron foundry and machine shops in North Wilkesboro, N. C.

The Tremont Engine and Boiler Works of Schuylkill County, Pa., has been chartered, with a capital stock of $100,000.

The Henry Dalton & Sons Co. has filed articles of incorporation at Oakland, Cal; capital stock, $100,000. The purpose is to conduct foundry and machine shops, etc.

The City Council (Richmond, Va.) has adopted a resolution appropriating $125,000 of 4 per cent. city bonds, to be used for purchasing site and erecting an electric light plant.

Sandusky, Ohio, is endeavoring to raise $150,000 for the purpose of inducing an eastern concern, known as the Aluminum Steel and Alloy Company, to locate a plant in that city.

The Holland Radiator Manufacturing Co., of Chicago, Ill., is contemplating establishing a plant in Harriman, Tenn., for the manufacturing of steam and hot water radiators, etc.

A new blooming-mill, 64x144 feet, will be erected by the Midland Steel Co., of Muncie, Ind., to be built in connection with the rolling-mill. It will give work to an additional 150 men.

The Horton Iron Co. has been organized at Duluth, Minn., with a capital stock of $500,000; incorporators, R H. Harris, R. P. Edson, H. B. Moore and W. G. Horton, of Mayville, N D.

The Dickinson Arms Co., Little Rock, Ark., has been organized, with W. W. Dickinson, president; T. F. Darragh, vice-president, and J. W. Dickinson, secretary. The capital stock is $25,000.

The Stupp Bros. Bridge and Iron Co., of St. Louis, are enlarging their plant by a 40x60 foot addition to their works, and considerable new machinery. Still further equipment is contemplated.

The Williams Engine Co., Baltimore, Md., write us that their business is driving them, orders being brisk and inquiries numerous. They are putting in new tools especially suited to their work.

The Noble Bros. Company, capitalized at $25,000, have been incorporated to operate the Murray & Stevenson foundry and machine shops, at Anniston, Ala., the same having been purchased by the company.

H. C. Valentine and others have leased the foundry at the Valentine Iron Works, near Bellefonte, Pa., for the purpose of starting a scale factory, and a large force of men are already at work on the buildings.

In Fernandina, Fla., work is progressing on the car shops of the Florida Central & Peninsular R. R., and as soon as completed the machinery of the temporary shops at Tallahassee will be removed to Fernandina.

The Union Iron Works at San Francisco, Cal., have purchased the Pacific Iron Works. The purchase includes the tools, patterns, drawings, engines, boilers, shafting, etc., and good will, but not stocks or accounts.

N. E. Ayer & Co. will establish a rolling mill at Portland, Ore., for the manufacture of merchant bar-iron. Work will begin at once, and it is expected that the plant will be in operation, employing 100 hands, by July next.

The Comins Mfg. Company have been organized at Columbus, Ohio, with a cash capital of $25,000. The company will occupy the old Stevenson Foundry, and engage in the manufacture of engines and boilers, and other mechanical appliances.

The Pittsburgh Tin-plate Works; capital, $60,000; to manufacture iron or steel, or both, or any other metal or of any article of commerce from metal or wood or both; incorporators: W. P. Beaver, Jas. B. Strawbridge, W. N. Voegtly.

J. Wendell Cole, P. O. Box 84, Columbus, Ohio, and Box 152, Chicago, Ill., has issued a very neat and comprehensive circular, illustrating and describing the Sellers tool grinder. Mr. Cole is special sales agent for a large variety of grinding machines.

The Springfield Iron Company, of Springfield, Ill., are increasing their capacity for the production of track bolts. Additional machines have been added, and the company will shortly be in a position to turn out at least 50 per cent. more than hitherto.

Last week the rolling-mill of the Roanoke Iron Co., at Roanoke, Va., commenced operations. Eleven of the 15 furnaces were lighted, giving employment to 100 men, and the remaining 4 will be lighted soon, which will give employment to an additional 50 men.

The Columbia Car and Tool Works, of Portland, Oregon, has been formed for the manufacture and sale of machinery, cars, etc. The capital stock of the company is $100,000. Henry Halen, H. H. Lovejoy, Leo Fried and Maurel Heacock are the promoters of the project.

The Schenectady Locomotive Works, Schenectady, N. Y., have awarded John McDermott, of that city, the contract to build for them a capacious new foundry. The new building will be 346 feet long and 100 feet wide, and will be located on the east side of Romeyn street.

The American Coal Co., recently incorporated at Birmingham, Ala., with Victor Gage as president, will develop coal mines in Walker County. Outfit of machinery for a daily output of 500 tons will be put in at once, and the president of the company is now in the market for the requisite machinery.

The electric power plant at Camden, Ark., is to be greatly improved. A powerful engine, 280 horse-power, and a sixty arc dynamo are en route from the Thomson-Houston Company's factory, in New York, and upon their arrival work will commence at once toward putting the plant in good order.

J. & J. B. Milholland, Pittsburgh, Pa., builders of wire rope haulage engines, hoisting engines and other mining machinery, steam engines, etc., have contracted for the building of an addition to their shop 40x100 feet, three stories high. They will equip this addition with special tools suited to their work.

Mr. William Lodge has withdrawn from the management of the manufacturing department of the Lodge & Davis Machine Tool Company, at Cincinnati, and is getting ready to build a line of machine tools in an establishment of his own in the same city. We understand that he still retains his financial interest in the L. & D. M. T. Co.

A new corporation, known as the Finch Mfg. Company, and composed of local capitalists, have made arrangements to purchase the plant of I. A. Finch & Co., at Scranton, Pa. The new concern has a capital stock of $400,000. The foundry plant, which now embraces a tract 450x250 feet, will be considerably enlarged and improved.

The Schuster Foundry Company has been organized, at South Pittsburgh, Tenn., to manufacture coil pipe under patents of L. Schuster, of Philadelphia. The company has already commenced operations in temporary quarters, and will at once erect a building 80x200 feet. Forty workmen are now employed, most of them being skilled.

J. F. Gibb has bought out the interest of Geo. W. Barrett and Z. T. Babcock, in the Geo. W. Barrett Elevator and Machine Works, Cleveland, O., and will, in conjunction with John R. Dick, the remaining partner, carry on the business under the name of The Columbia Elevator and Machine Works, builders of passenger and freight, steam, hydraulic electric and hand-power elevators.

The Rue Manufacturing Co., 118 North Ninth street, Philadelphia, Pa., has issued a new catalogue of the "Little Giant" and "Unique" injectors, boiler washing and testing machines, ejectors, etc. The different appliances are illustrated; also the manner of applying both the lifting and non-lifting injectors of each kind. These injectors are made for all kinds of service where an injector is required.

Mr. Benj. Sebastian, Jr., who was formerly at the head of the Sebastian-May Company, of Cincinnati, and later of Sidney, Ohio, withdrew from that company some time ago, and has now organized the Sebastian Lathe Company at Cincinnati. With an experience of some seventeen years in the tool business, Mr. Sebastian has reason to think that the new company will be able to secure its share of the business.

It is officially announced that the New York Central Railroad will build shops just outside Buffalo that will employ 1,200 to 1,500 men. Work will be begun April 1, and it is intended to have them so far complete in July that 700 men can be employed on repairs. The intention is to increase the shops later on so as to embrace the building of locomotives. The shops and tracks will occupy 100 acres of land. It is understood that the shops of the Central at Syracuse will be abandoned as soon as the Buffalo shops are ready for occupancy.

We have received the catalogue of the Boston Gear Works, of 31 Hartford street, Boston, Mass. The front of the cover is embellished with an embossed bronze gear wheel, and within the covers will be found a great deal of information relating to gear wheels. The list of brass gears is especially full and complete. A new gear gauge is described and illustrated and also fiberoid gears, which are used where it is important to do away with noise at high speeds. The last two pages contain useful tables and formulas to be used in connection with gearing. The catalogue is free to business firms; others are charged 10 cents for it, which is refunded with the first order.

Machinists' Supplies and Iron.

NEW YORK, March 19, 1892.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $16.50 to $17.50; No. 2, $15.25 to $16.50; Grey Forge, $14 to $14.50. Southern brands of good quality are obtainable at $15.75 to $17 for No. 1 Foundry; $15 to $16 for No. 2; and $13.50 to $14 for Grey Forge.

Scotch Pig—Coltness is quoted at $21; and $20.25 for Eglington.

Antimony—The market is stronger.

We quote Hallett's, 10.80c. to 10.90c.; Cookson's, 14½c. to 15c; and L. X., 12c. to 12½c.

Copper—The market has advanced. For Lake Copper 11⅝c. to 11¾c. is asked. Casting Copper rules at 11⅛c. to 11¼c.

Lead—Sales are reported at 4.15c. and a shade under. The best bid is 4.10c. with 4.15c. asked.

Lard Oil—The market is firm at 56c. to 57c. for Prime City. Western on spot is quoted at 55c. to 56c.

Spelter—The market continues more or less nominal at 4.50c. to 4.55c. for New York delivery.

Tin—The spot market is weaker at 19.60c. quoted for spot, with sales of 20 tons for July delivery at 19.70c.

WANTED

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. Seven words make a line, and the address as desired to appear should be included. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—A1 Piper, Kidder Machine Company, Franklin Falls, N. H.

Three first-class tool makers wanted by the Ottumwa Iron Works, Ottumwa, Iowa.

Position wanted by a young man who is a first-class metal pattern maker; best of references. BOX 77, AMERICAN MACHINIST.

Wanted—Situation by an all-round machinist accustomed to handling men and tools to produce work at least possible cost. Box 78, AM. MACH.

Wanted—Position as traveling salesman by practical machinist, American; 2 years on the road; engines or other machinery pref'd. Box 43, AM. MACH.

A first-class designer and builder of special tools wants position; at present have charge of electric shop. Address Box 73, AMERICAN MACHINIST.

Wanted—Position as draftsman by an apprenticed mechanic, with tech. education and exp. in drafting-room; age, 23. W. L. S., AM. MACHINIST.

Wanted—Draftsman exp. in the designing of modern steam pumping mach'y. Apply stating age, exp. and salary expected to Ohio, AM. MACHINIST.

Wanted—Foundry foreman desires a position, well posted in all details. A1 references. Address Box 79, AMERICAN MACHINIST.

Wanted—Situation by a practical blacksmith accustomed to all kinds of mach'y forging, tool dressing, tempering, etc., best of refs. B. K. S., AM. MACH.

Wanted—A skillful machinist to act as foreman of a medium size, first-class machine shop. References required. Box 80, AMERICAN MACHINIST.

A young carriage-smith of 20 will work a month for an opportunity to learn the machinist's trade in a good shop. Address Reader, AMER. MACHINIST.

A young man (25) wants position as ass't engineer; has N. Y. license; good lathe hand and draftsman. S. W., AMERICAN MACHINIST.

Wanted—Position by mech. draftsman with large exp. in constructing hoisting mach'y for electric, hydraulic, steam and hand power; used to making calculations and estimates. Time, AM. MACHINIST.

Wanted—Man of 32, with long and successful experience as machinist, foreman and supt., good draftsman and designer of tools and mach'y, wants situation about May 1. "Ability," care AM. MACH.

Wanted—First-class machinery salesman for Chicago and vicinity; must be well up in machine tools; a good place for the right party with one of the largest manufacturers in the U. S. Address "Masheen," care AMERICAN MACHINIST.

A mechanical engineer in good position now, well experienced in marine work, steam and hydraulic engineering, 6 years shop and 10 years office experience, wants position as assistant superintendent or manager in or near New York. First-class references. Address Box 76, AMERICAN MACHINIST.

Wanted—A new Mfg. Co. located at Alexandria, Va. (7 miles from Washington, D. C.), desires to enlarge its machine shop for outside work, and a thorough machinist having either capital or mach'y and tools will be offered good inducements to take charge of machine shop. State experience and refs. Potomac Novelty Co., Ltd., Alexandria, Va.

A mechanical engineer; a capable and experienced manager with good executive ability is open for engagement. Exp'd in modern methods of manufacture, in interchangeable work, and in handling help; a successful designer of special and automatic mach'y; have had exp. in designing and erecting factories. A1 ref. Advancement, AM. MACH.

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THE BUNNELL FILTER AND PROCESS Furnishes Steam Boilers with water that is absolutely freed from all scale producing substances. Guaranteed or no sale.

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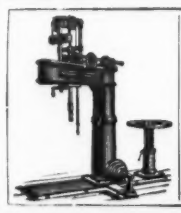

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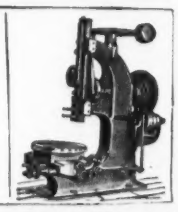

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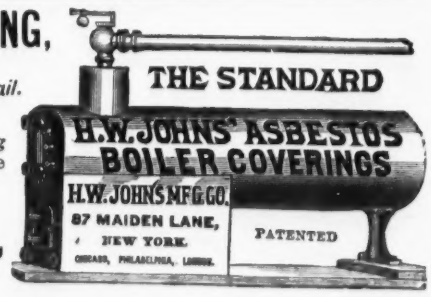

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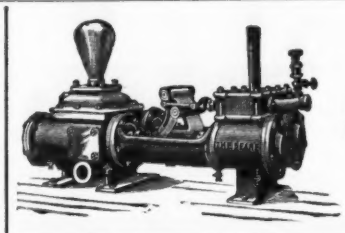
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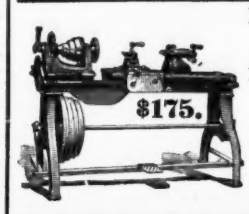
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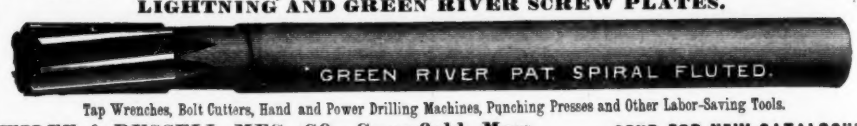
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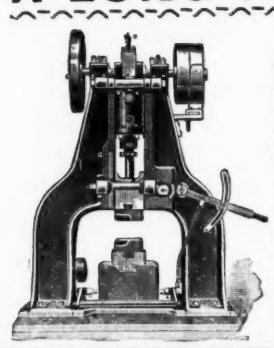
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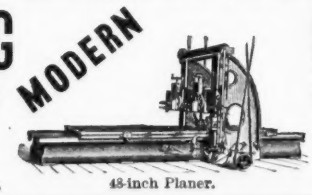
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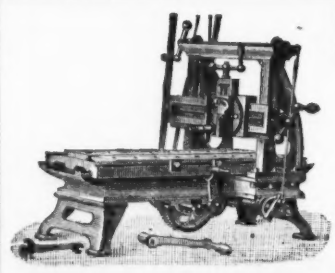
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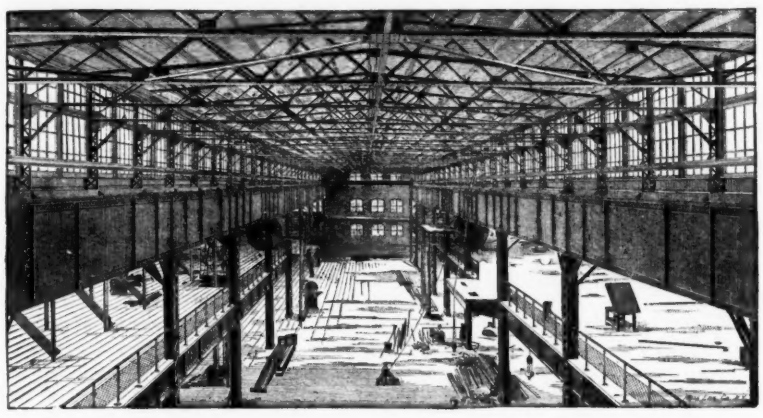

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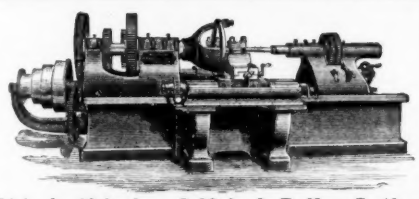

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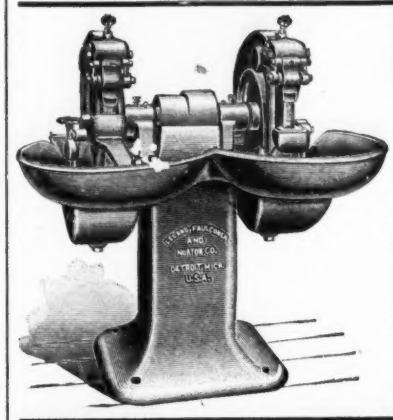

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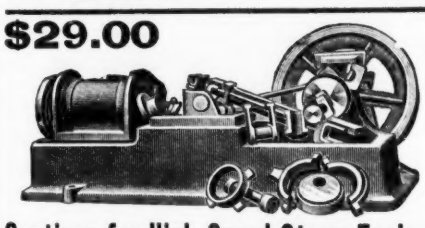

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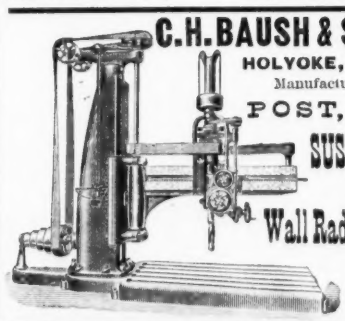

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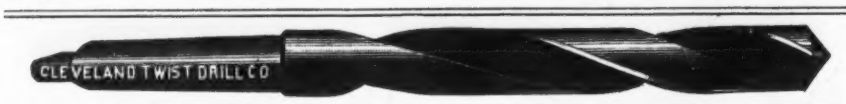

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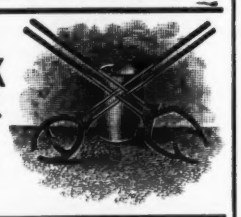
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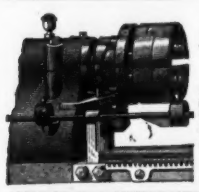
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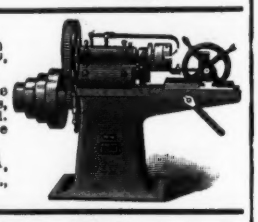

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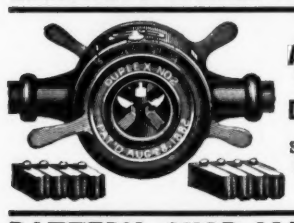
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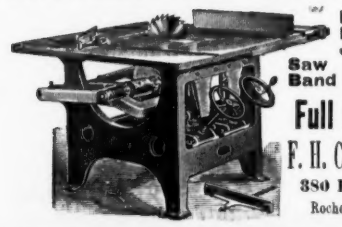
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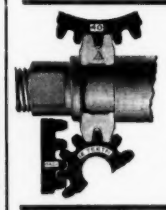
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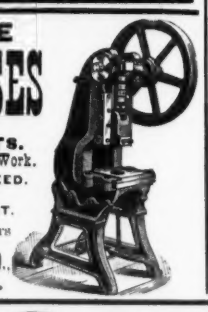

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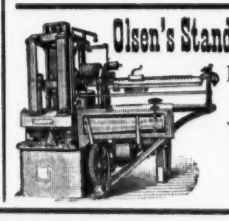
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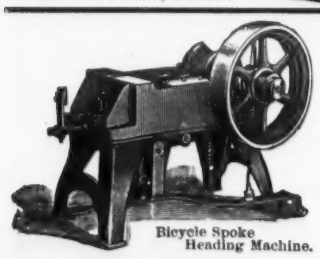
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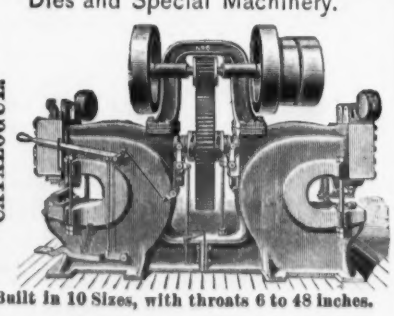
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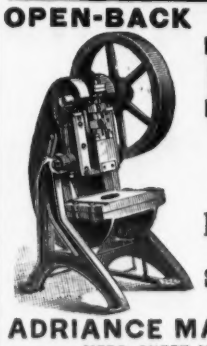
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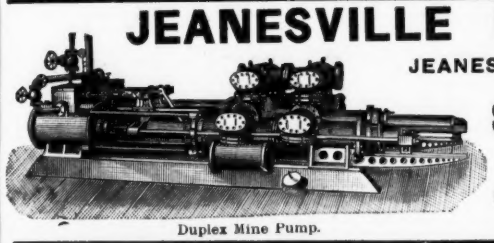
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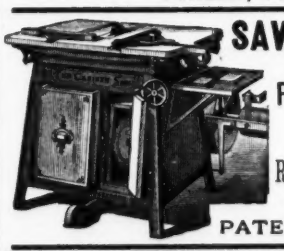
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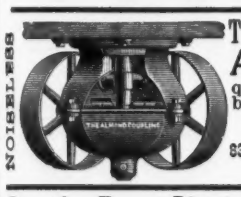
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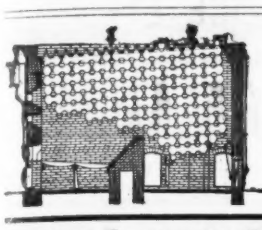

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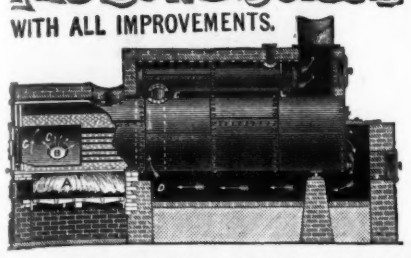

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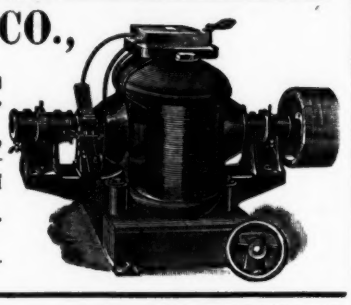

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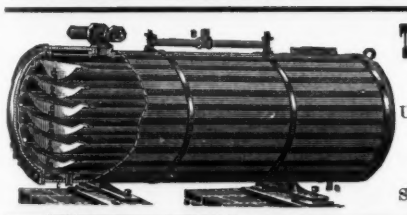

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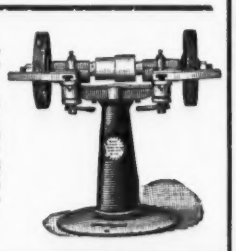

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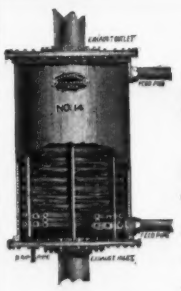

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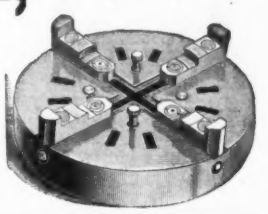

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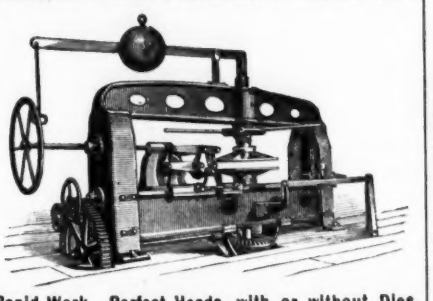

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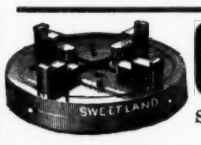

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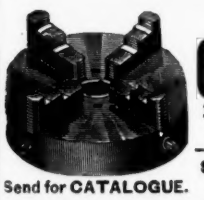

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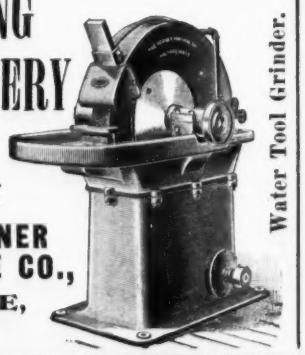

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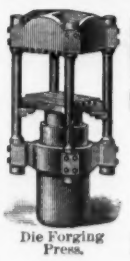

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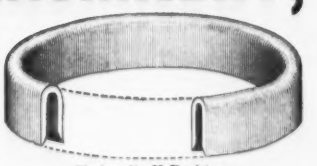

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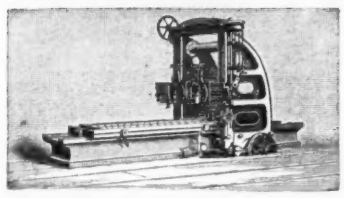

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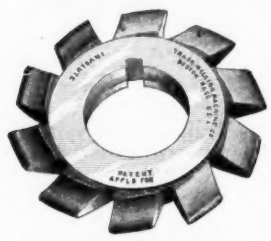

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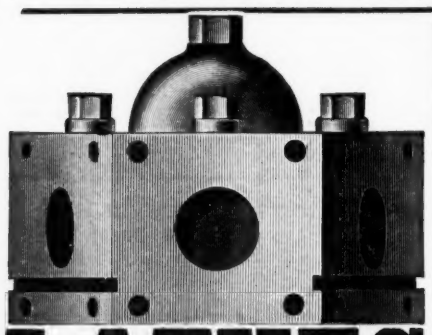

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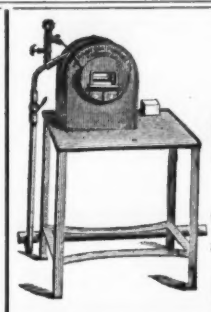

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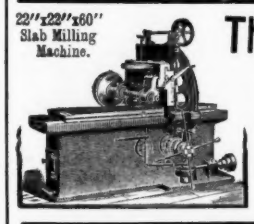

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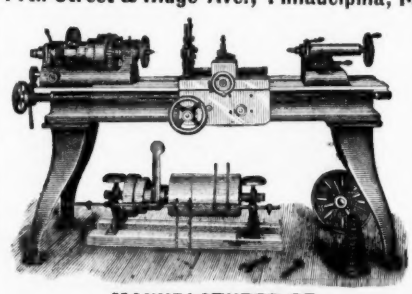

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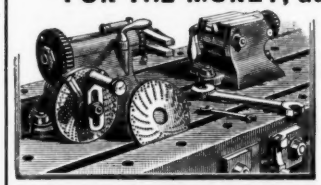

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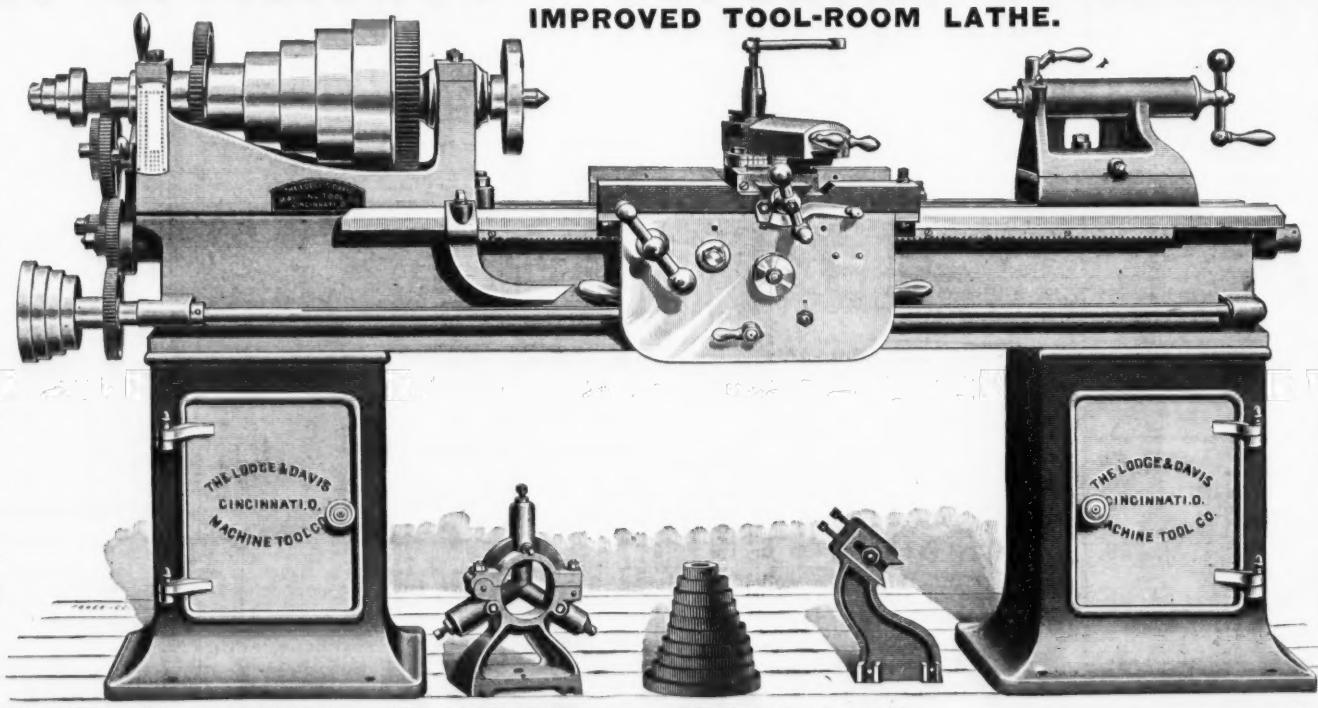

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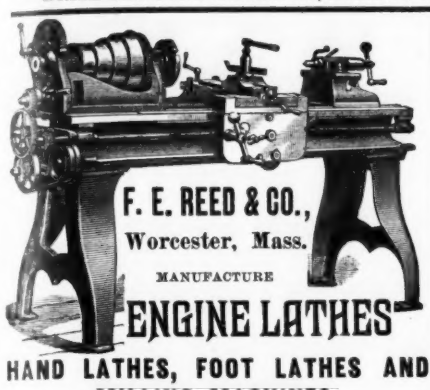

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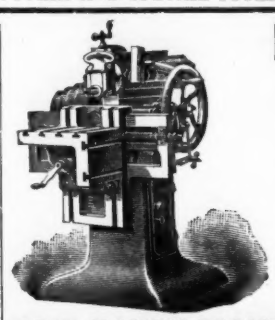

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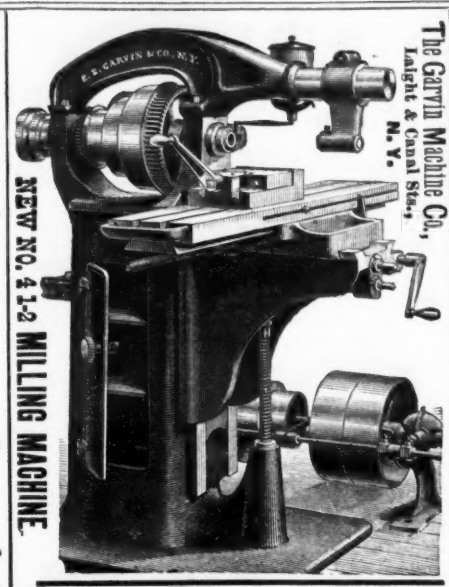

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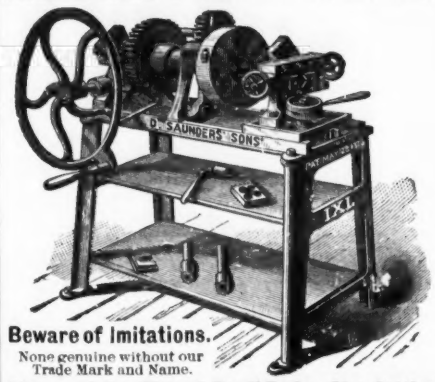

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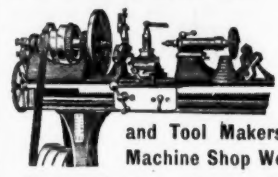

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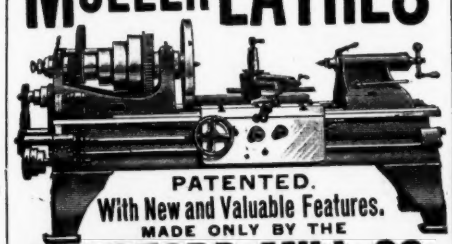

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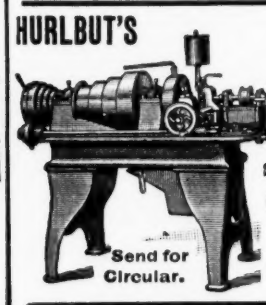

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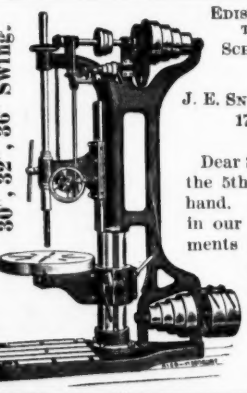

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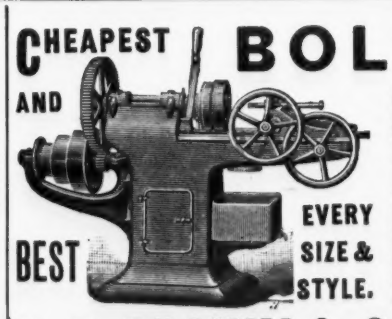

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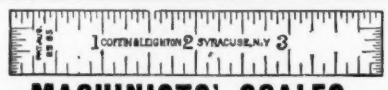

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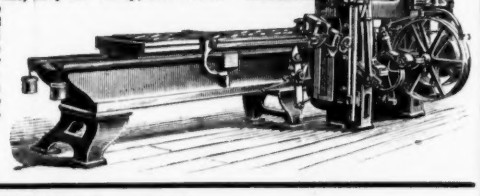

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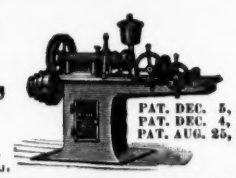

PAT. DEC. 5, 1882.
PAT. DEC. 4, 1883.
PAT. AUG. 25, 1885.

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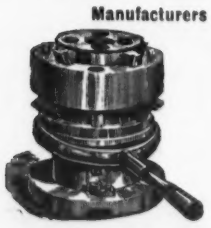

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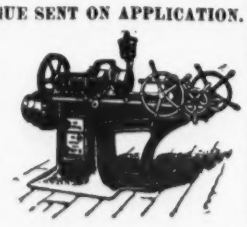

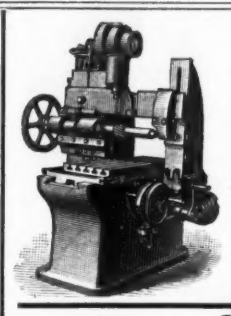

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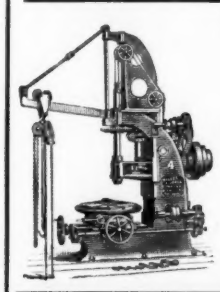

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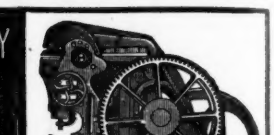

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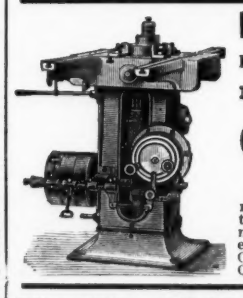

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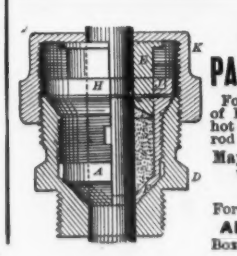

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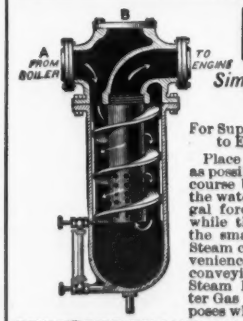

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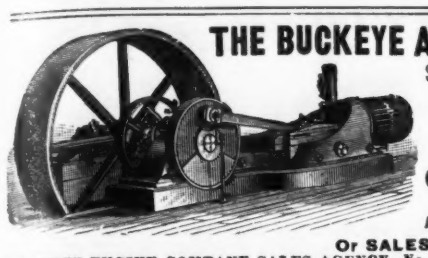

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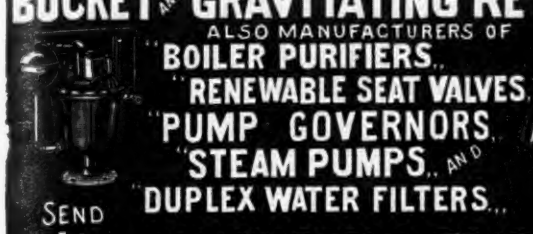

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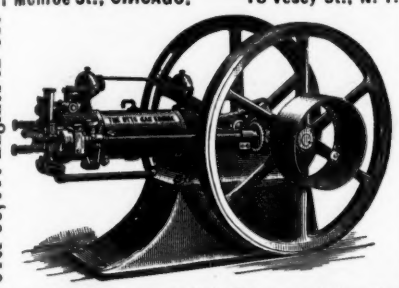

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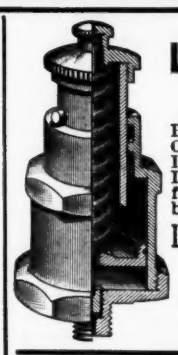

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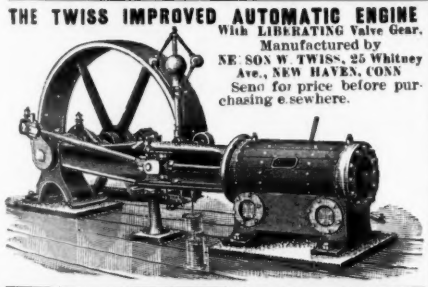

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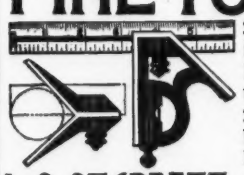

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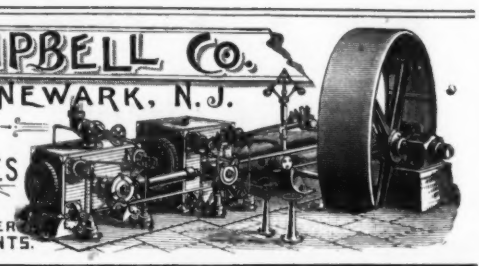

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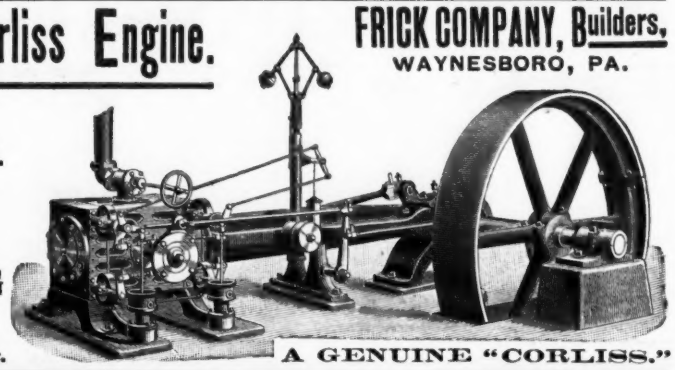

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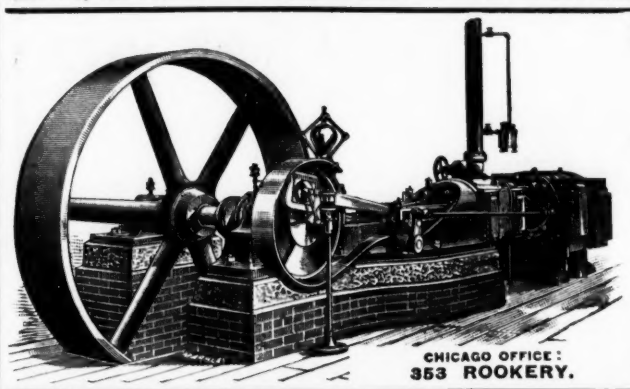

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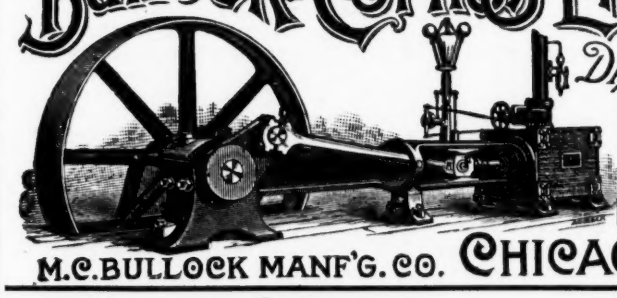

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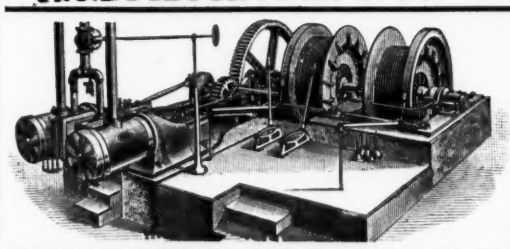

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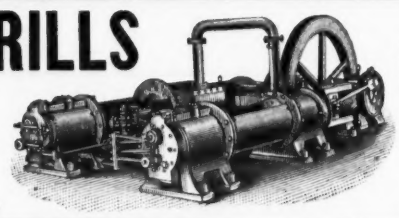

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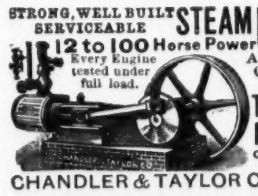

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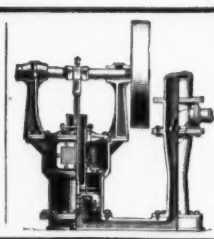

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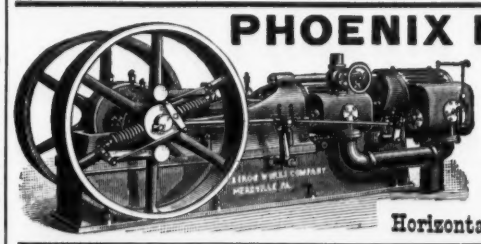

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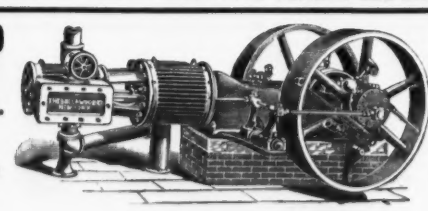

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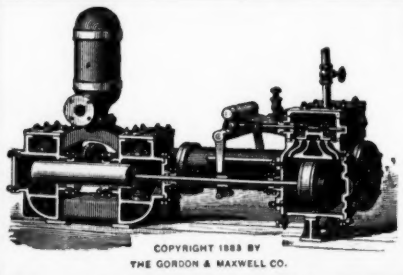

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Communications can be addressed to the Works or to our Stores, where the Tool Room Lathes will be on exhibition.

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☞ See advertisement, page 16.

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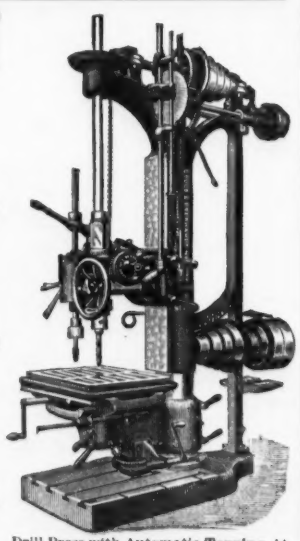

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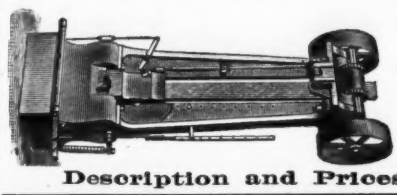

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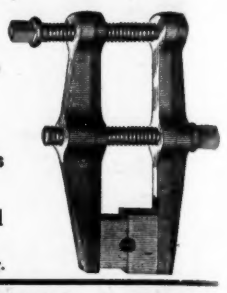

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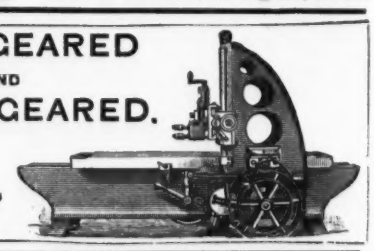
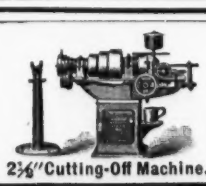
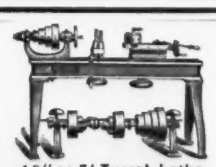
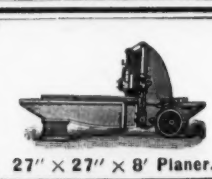




2½" Cutting-Off Machine.



15" × 5' Turret Lathe.



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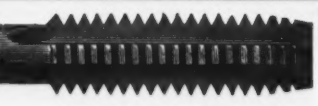

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